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DEPARTMENT OF HIGHWAYS

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RESEARCH PROJECT
JHRP-88/16

ENGINEERING SOILS MAP OF KNOX COUNTY, INDIANA
FINAL REPORT

Gregory L. Johnson

PURDUE UNIVERSITY

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FINAL REPORT

ENGINEERING SOILS MAP OF KNOX COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

November, 1988

Project No: C-36-51B

FROM: Robert D. Miles, Research Engineer
Joint Highway Research Project

File: 1-5-2-82

The attached report entitled "Engineering Soils Map of Knox County, Indiana," completes a portion of the long term project concerned with the development of county engineering soils maps of the 92 counties of Indiana. This is the 82nd report of the series. The report was prepared by Gregory L. Johnson, Research Assistant, Joint Highway Research Project.

The engineering soils mapping of Knox County was done primarily by the analysis of landforms and associated parent materials portrayed on stereoscopic aerial photographs. Some test data from soil borings were obtained from IDOH and are summarized in the report. Generalized soil profiles for the landforms mapped are presented on the engineering soil map included at the end of the report.

Respectfully submitted,

Robert D. Miles

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FINAL REPORT

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF KNOX COUNTY

by

Gregory L. Johnson
Research Assistant

Joint Highway Research Project

Project No.: C-36-51B

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The author finally wishes to thank his parents for their support and encouragement throughout his educational career.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS.. iii

LIST OF TABLES.. vi

LIST OF FIGURES.. vii

LIST OF APPENDICES.. ix

INTRODUCTION.. 1

DESCRIPTION OF KNOX COUNTY.. 2

- GENERAL.. 2
- CLIMATE.. 5
- DRAINAGE FEATURES.. 7
- WATER SUPPLY.. 12
- PHYSIOGRAPHY.. 14
- TOPOGRAPHY.. 14

GEOLOGY OF KNOX COUNTY.. 19

- BEDROCK GEOLOGY.. 19
- PLEISTOCENE GEOLOGY.. 26

LANDFORM-PARENT MATERIAL REGIONS.. 32

- EOLIAN DRIFT.. 36
  - Loess Plain.. 37
  - Loess over Slackwater Plain.. 39
  - Loess over Sandstone-Shale Bedrock.. 40
  - Sand Dunes.. 41
  - Sand with Incipient Dune Development.. 42
  - Sand Dunes over Sandstone-Shale Bedrock.. 43
  - Engineering Considerations in Eolian Drift 44
- LACUSTRINE DRIFT.. 48
  - Lacustrine Plain.. 50
  - Slackwater Plain.. 51
  - Slackwater Terrace.. 52
  - Oxbow.. 53
  - Engineering Considerations in Lacustrine Drift 53
- FLUVIAL DRIFT.. 57

Wabash and White River Flood Plains.................... 57
Tributary Flood Plains................................. 59
River Terrace.. 60
Engineering Considerations in Fluvial Drift 60

GLACIAL-FLUVIAL DRIFT..................................... 62

Outwash Terrace.. 62
Engineering Considerations in Glacial-Fluvial Drift ... 63

CUMULOSE DRIFT.. 64

Muck and Marl Deposits................................. 64
Swamp Deposits... 65
Engineering Considerations in Cumulose Drift 65

MINED LAND.. 67

Coal-Strip Mines....................................... 67
Gravel Pits.. 68
Engineering Considerations in Mined Land 69

SUMMARY OF ENGINEERING CONSIDERATIONS IN KNOX COUNTY 72

REFERENCES... 78

APPENDICES... 83

LIST OF TABLES

Page

1. Land Use in Knox County.................................... 4

2. Population Summary of Knox County.......................... 5

3. Climatological Summary for Knox County..................... 6

4. Drainage Densities for Selected Streams in Knox County..................................... 10

5. Oxbow Lakes in Knox County................................. 11

6. Hills of Circumnavigation in Knox County................... 18

7. Summary of Engineering Considerations for Landform-Parent Material Regions in Knox County..................................... 73

8. Typical Properties of Compacted Materials.................. 77

LIST OF FIGURES

		Page
1.	Location Map of Knox County	3
2.	Drainage Map of Knox County	8
3.	Major Watersheds of Indiana	9
4.	Groundwater Sections of Indiana	13
5.	Physiographic Units and Glacial Boundaries in Indiana	15
6.	Topography of Knox County	16
7.	Bedrock Geology of Knox County	20
8.	Structural Setting of Knox County	21
9.	Generalized Geologic Cross-Section Through Knox County	22
10.	Columnar Section Showing Bedrock Stratigraphy of Knox County	23
11.	Bedrock Geology of Knox County	25
12.	Topography of Bedrock Surface in Knox County	27
13.	Block Diagram of Lacustrine/Outwash Association in Tributary Valleys	30
14.	Generalized Cross-Section of the Wabash River Valley	33
15.	Unconsolidated Deposits in Knox County	34
16.	Thickness of Unconsolidated Deposits in Knox County	35
17.	Loess Thickness Map of Knox County	38
18.	Potential for Loess Settlement	45
19.	Resistance for Earth Dam Embankment Materials to Piping and Cracking	47

20. Grain-Size and Strength Characteristics of Most Liquefiable Soils.................................... 49

21. Slope Stability of Lacustrine Drift.......................... 55

22. Major Underground Coal Mines in Southwestern Indiana.. 71

23. Correlations of Strength Parameters.......................... 75

24. Correlations of Standard Penetration Resistance.. 76

LIST OF APPENDICES

Page

A. Classification Test Results for Selected Engineering Projects in Knox County........................... 83

B. Physical and Chemical Properties of Agricultural Soils in Knox County............................ 89

C. Engineering Index Properties of Agricultural Soils in Knox County............................ 94

D. Statistical Stream Flow Data for Selected Streams in Knox County.............................. 100

- D-1. Wabash River at Vincennes.......................... 101
- D-2. White River at Petersburg.......................... 104
- D-3. Busseron Creek near Carlisle....................... 107

E. Low-Flow Characteristics for Selected Steams in Knox County.. 110

- E-1. Wabash River at Vincennes.......................... 111
- E-2. White River at Petersburg.......................... 112
- E-3. Busseron Creek near Carlisle....................... 113
- E-4. Maria Creek near Emison............................ 114

F. Loess Thickness Measurements in Knox County... 115

ENGINEERING SOILS MAP
OF
KNOX COUNTY, INDIANA

INTRODUCTION

The engineering soils map of Knox County, Indiana which accompanies this report was prepared primarily by airphoto interpretation techniques using accepted principles of observation and inference (1). The 7" x 9" aerial photographs used in this study, having an approximate scale of 1:20,000, were taken in the summer of 1940 for the United States Department of Agriculture and were purchased from that agency. The attached engineering soils map was prepared at a scale ratio of 1:63,360 (1 inch = 1 mile).

Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate landform-parent material associations and soil textures. The text of this report represents an effort to overcome the limitations imposed by adherence to a standard symbolism and map presentation.

Extensive use was made of the Agricultural Soil Survey of Knox County published in 1981 (2). It was particularly useful as a cross-reference to check soil boundaries and in locating strip mines, gravel pits, ponds, and stream meanders not present on the 1940 aerial photographs. Also, a reconnaissance trip was made to the county to resolve ambiguous soil boundaries.

The map and report are part of a continuing effort to complete a comprehensive engineering soil survey for the state of Indiana. Therefore, a consistent mapping of soil units at the boundaries of previously mapped

Sullivan, Daviess, Pike, and Gibson Counties was attempted.

Included on the map is a set of subsurface profiles. They illustrate approximate variations that are expected in the general soil profiles of the major soils of each landform-parent material area. The profiles were constructed from information obtained from agricultural literature and from boring data collected for roadway and bridge site investigations (41-56). Boring locations are shown on the map, and Appendix A contains a summary of classification test results for these locations.

The text of this report supplements the engineering soils map and includes a general description of the study area, descriptions of the different landform-parent material areas, and a discussion of the engineering considerations associated with the soils found in Knox County.

The predominant agricultural soils associated with each landform-parent material classification are covered in the discussion of the different landforms in the county. The physical, chemical, and engineering index properties of these soils are included in Appendices B and C.

DESCRIPTION OF THE AREA

GENERAL

Knox County is located in southwestern Indiana as illustrated in Figure 1. The county is bounded on the west by the Wabash River, and on the east and south by the White River. It has the distinction of possessing more river boundary than any other county in the state (3). The northern boundary of the county follows the east-west line of the northern edge of T5N, 2nd PM. It is bordered on the north by Sullivan and Greene, east by

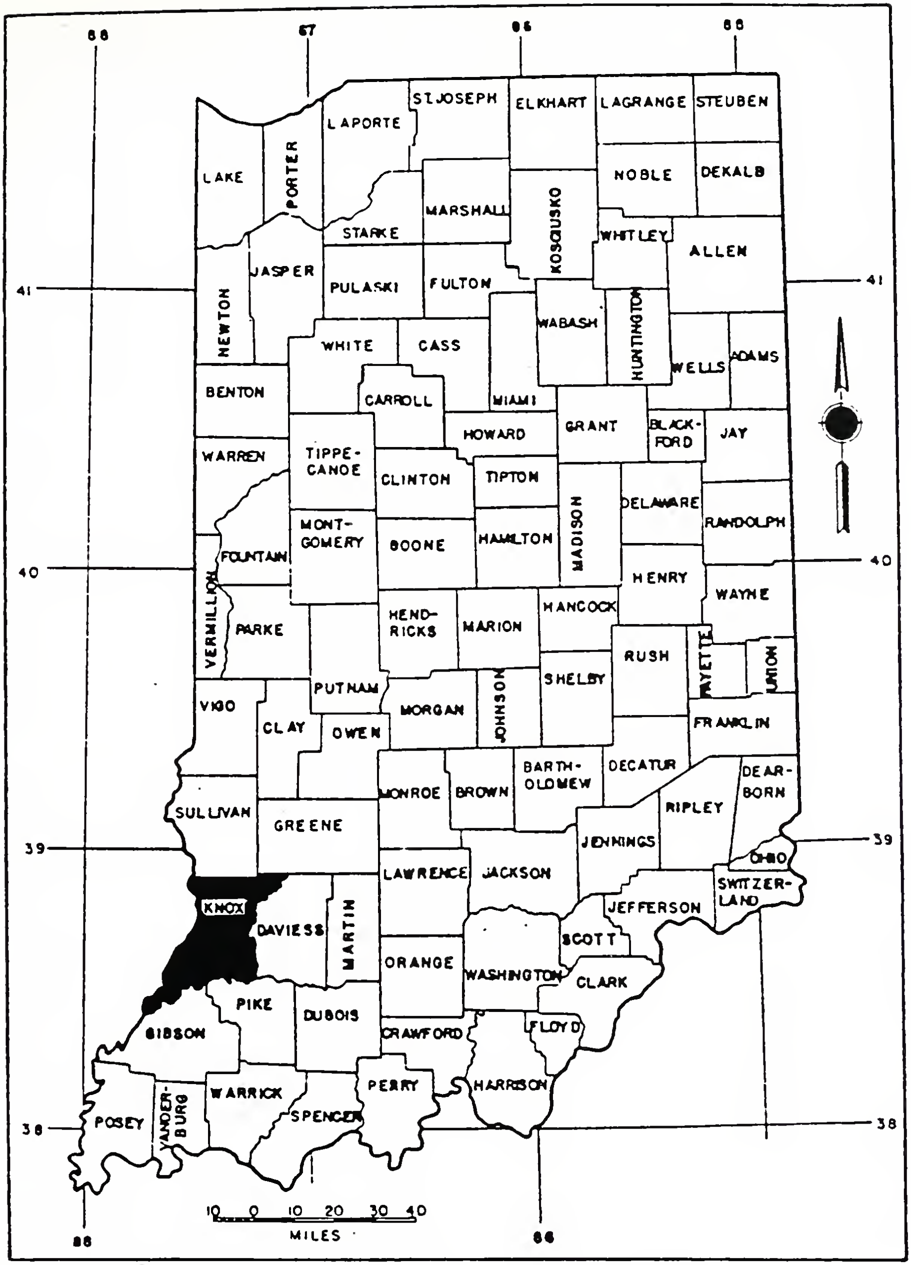


FIGURE 1. LOCATION MAP OF KNOX COUNTY.

Daviess, south by Pike and Gibson Counties and on the west by the State of Illinois. Vincennes, the county seat, is located along the Wabash River in the west-central part of the county, approximately 105 miles southwest of Indianapolis.

Knox County was named in honor of Henry Knox, the first secretary of war (2). It was the first county formed in the old Northwest Territory, and originally covered all of Indiana and parts of Ohio, Illinois, Michigan, and Wisconsin. About 1815 it was given its present boundaries (2). A large portion of the county was settled before the adoption of the rectangular system of survey, therefore only a portion of the county is divided into sections, while other portions are divided into metes and bounds surveys and donations. The dividing lines, in most cases, run northeast-southwest and northwest-southeast, though in some cases they are quite irregular (4).

The county has a land area of 516 square miles, or 330,240 acres. The greatest use of land within the county is for agriculture followed by forested lands (5). Most urban development is centered around Vincennes. General land-use categories by area and percent of total area are listed in Table 1.

TABLE 1. LAND USE IN KNOX COUNTY (5).

Land Use	Acres	Percent
Agriculture	266,500	80.7
Urban	15,814	4.8
Forest	38,000	11.5
Water	2,091	0.6
Wetland	30	<0.1
Mined Land	311	0.1
Other	7,494	2.3
Total	330,240	100.0

Knox County has a population of about 41,838 (1980 census). The population remained relatively stable between 1970 and 1980. A population summary of the cities and towns in the county is given in Table 2.

TABLE 2. POPULATION SUMMARY OF KNOX COUNTY (6).

City/Town	1980	1970	Difference	% Change
Bicknell	4,713	3,717	996	26.80
Bruceville	646	627	19	3.03
Decker	256	268	-12	-4.48
Edwardsport	459	482	-23	-4.77
Monroe City	569	603	-34	-5.64
Oaktown	776	726	50	6.89
Sandborn	567	528	48	9.09
Vincennes	20,857	19,867	990	4.98
Wheatland	523	562	-30	-5.34
Cities/Towns	29,384	27,380	2,004	7.34
Rural Areas	12,454	14,166	-1,712	-12.09
County Total	41,838	41,546	292	0.70

CLIMATE

The climate of Knox County is continental, humid, and temperate with hot summers and moderately cold winters. Table 3 gives data on temperature and precipitation for the area, as recorded at Vincennes, for the period 1951 to 1974 (2).

The average winter temperature is 32 degrees F, with the lowest temperature on record being -19 degrees F. In summer the average temperature is 75 degrees F, with the highest recorded temperature being 107 degrees F. Of the total annual precipitation, approximately 60 percent falls between April and September. Average seasonal snowfall is 13 inches. The prevailing wind is from the south-southwest with the highest average windspeed, 10

TABLE 3. CLIMATOLOGICAL SUMMARY FOR KNOX COUNTY (2).

Month	Temperature			Precipitation			
		2 yrs in 10 will have a			2 yrs in will have		
	Mean (deg F)	Maximum higher than (deg F)	Minimum lower than (deg F)	Mean (inches)	Less than (inches)	More than (inches)	Mean Snowfall (inches)
January	29.4	67	-9	2.65	1.41	3.65	3.1
February	33.1	69	-5	2.50	1.27	3.50	3.1
March	41.7	80	10	3.92	2.05	5.43	2.8
April	54.8	86	24	4.17	2.42	5.58	0.2
May	64.0	93	33	4.35	2.42	5.92	0.0
June	73.4	99	45	4.04	2.57	5.37	0.0
July	76.8	99	50	4.15	1.72	6.11	0.0
August	74.8	98	48	3.54	1.21	5.39	0.0
September	68.7	97	37	3.07	1.44	4.44	0.0
October	56.9	90	25	2.30	0.98	3.36	0.0
November	43.5	79	12	3.58	1.79	5.03	1.2
December	33.6	69	-2	3.41	1.76	4.75	2.7
Year	54.2	101	-10	41.68	35.71	47.40	13.1

mph, occurring in the spring (2).

DRAINAGE FEATURES

Drainage features of Knox County are shown in Figure 2, "Drainage Map-Knox County, Indiana," prepared by the Joint Highway Research Project, Purdue University, 1952 (7). Knox County lies within two major watersheds of the State of Indiana as illustrated in Figure 3. The western half of the county is located in the Wabash River watershed, while the remainder is in the White River watershed.

The main streams, from north to south, that drain the western half of Knox County to the Wabash River are Busseron Creek, Maria Creek, Smalls Creek, Snapp Creek, and Swan Pond Ditch. The main streams that empty into the White River, from north to south, are Black Creek, Splunge Creek, Indian Creek, Pond Creek, Wilson Creek, and Plass Ditch (7).

A well developed, fine-textured, subdendritic drainage pattern is found on the loess covered uplands in the central portion of the county. The flood plains of the Wabash and White Rivers have the anastomotic drainage pattern usually found in mature valleys. Sand areas, located throughout the county, exhibit a lack of developed surface drainage. The drainage of the extensive slackwater plains and low gradient alluvial plains have been augmented by many dredged ditches, creating a somewhat rectilinear pattern in these areas (7).

Drainage density data for selected streams in Knox County is given in Table 4 (8).

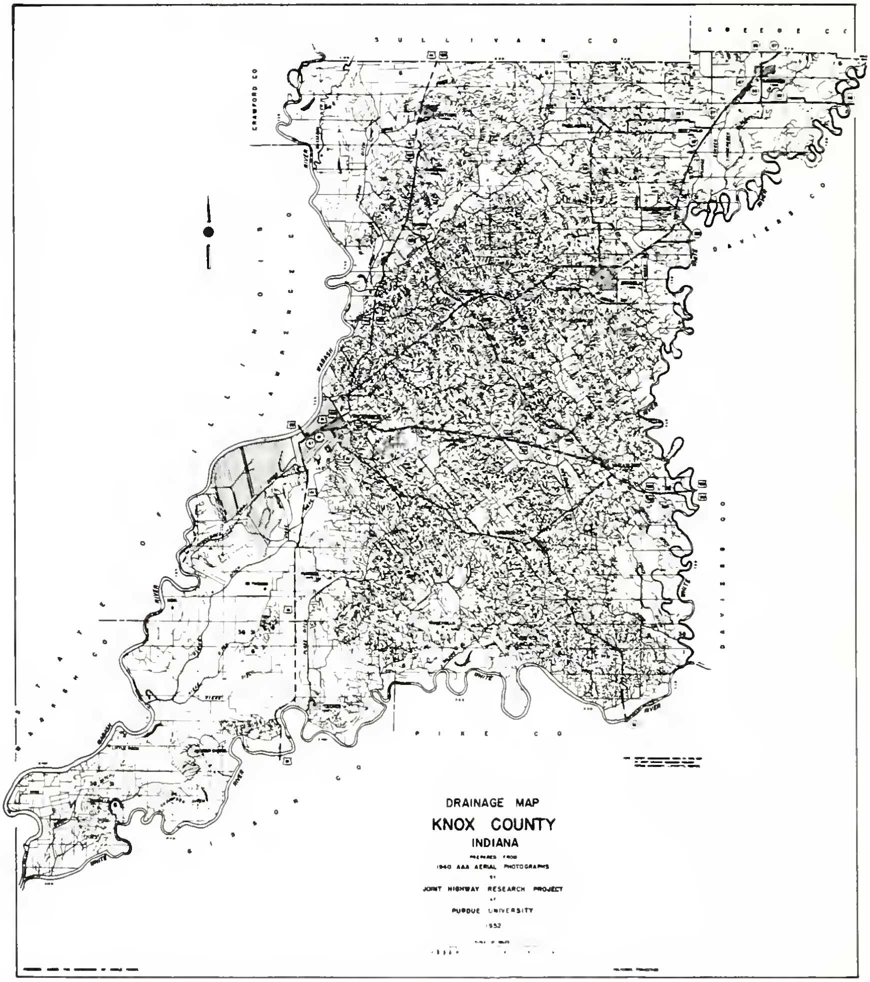


FIGURE 2. DRAINAGE MAP OF KNOX COUNTY (7).

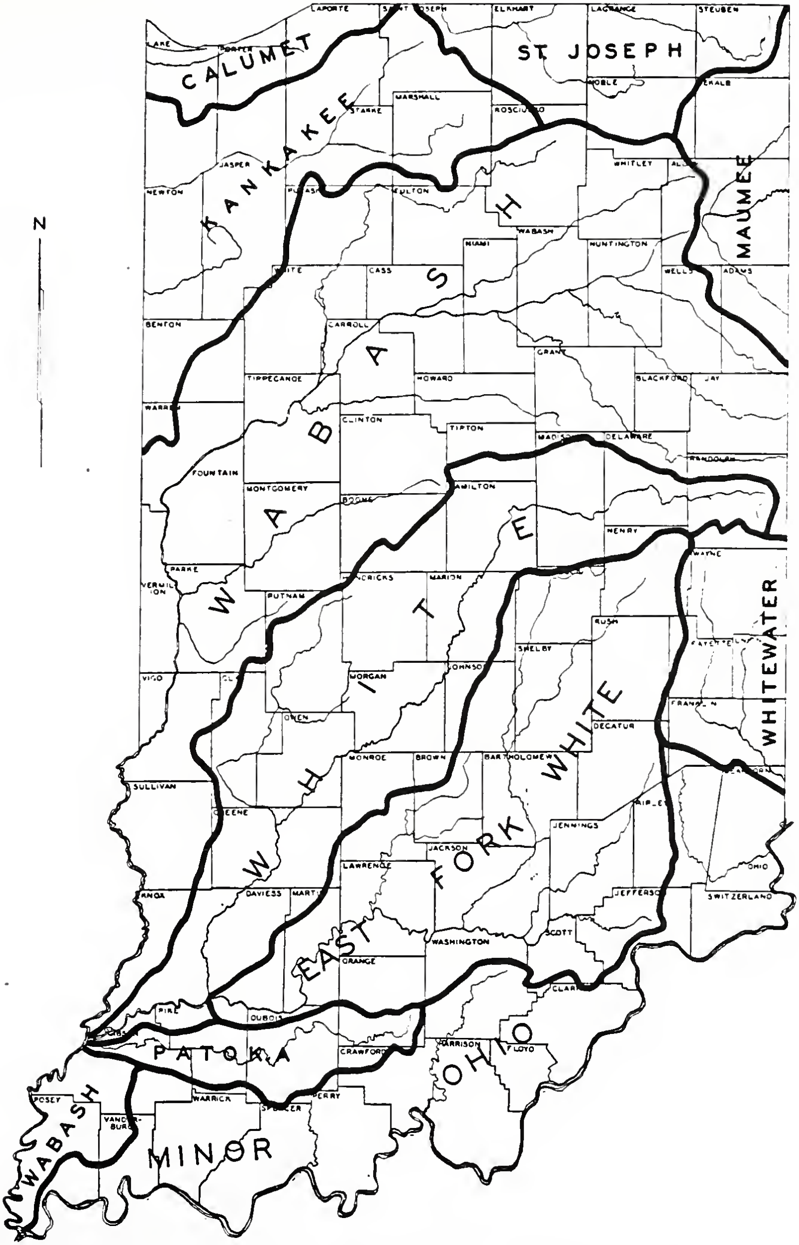


FIGURE 3. MAJOR WATERSHEDS OF INDIANA (26).

TABLE 4. DRAINAGE DENSITIES FOR SELECTED STREAMS IN KNOX COUNTY (8).

Stream and Location	Quad.	Section	Township	Range	Drainage Area (mi^2)	Drainage Density (streams/ mi^2)
Frick Ditch at Mouth	Monroe City	35	2N	8W	5.81	4.9
Indian Creek at Mouth	Wheatland	115	3N	8W	7.08	10.4
McCoy Creek at Mouth	Iona	168	2N	9W	4.15	9.1
River Deshee and Vieke Drainage	Decker	15	1N	11W	23.60	1.8
South Fork Smalls Creek at Mouth	Oaktown	191	4N	9W	6.08	11.0
Smalls Creek above S. Fork Smalls Creek	Oaktown	189	4N	9W	7.31	11.0
Smalls Creek at Mouth	Fritchton	35	4N	10W	18.30	9.8
Tilley Ditch at Mouth	Bicknell	237	5N	9W	8.93	9.4
Wison Creek above McCoy Creek	Iona	168	2N	9W	7.82	7.9
Wilson Creek at Mouth	Iona	5	1N	9W	19.90	5.8

Although there are no natural lakes in Knox County, numerous oxbow lakes have resulted from abandoned meanders of the Wabash and White Rivers. Some of the larger oxbow lakes are listed in Table 5 along with their locations.

TABLE 5. OXBOW LAKES IN KNOX COUNTY

Oxbow Lake	Floodplain	Location
Gray's Pond	Wabash	Sec 16, T5N, R10W
Brodies Lake	Wabash	Sec 27, 34; T5N; R10W
Maria Pond	Wabash	Sec 23, T4N, R10W
Horseshoe Pond	Wabash	Sec 14, T2N, R11W
Swan Pond	Wabash	Sec 4, T1N, R11W
Wabash Pond	Wabash	Sec 20, 21; T1S; R11W
Claypole Pond	White	Sec 6, T1S, R11W
Half Moon Pond	White	Sec 33, 34; T1N; R9W
Hills Pond	White	Sec 3, 4; T1N; R9W
Long Pond	White	Sec 23-26, T2N, R8W
Clear Pond	White	Sec 14, 23; T2N; R8W

Lakes formed by surface coal mining are abundant in the northeastern part of the county. The attached map shows a large concentration of coal-mine lakes near Bicknell. Also, many man-made lakes and farm ponds have been constructed in the uplands. Cypress Swamp occupies the Wabash floodplain in the extreme southwest portion of the county.

The meandering nature of the Wabash and White Rivers has isolated portions of Knox, Daviess, Gibson, and Pike Counties, as well as the State of Illinois, into several island-like tracts. Also, the courses of several small streams have been interrupted in many places by strip mining operations. Flooding over the wide flood plains of the Wabash and White Rivers is common during high water seasons (7). However, extensive levee development protects much of this area in Knox County.

Streamflow analyses for the Wabash River (at Vincennes), the White River (at Petersburg, Pike County), and Busseron Creek (near Carlisle, Sullivan County) are given in Appendix D. Each station analysis includes lowest and highest mean daily discharges; flow duration; statistics on normal monthly means, log monthly means, log annual means; and annual peak discharges (10).

Low-flow characteristics for the Wabash River, the White River, Busseron Creek, Maria Creek, and Black Creek are given in Appendix E. Selected low-flow frequency and flow-duration values are given for all five streams. Also, annual and summer (June-August) low-flow frequency data are presented, as well as duration data for the selected periods: 3 months (June-August), 3 months (August-October), 6 months (May-October), and 12 months (October-September) for the Wabash River, the White River, and Busseron Creek (11).

WATER SUPPLY

Knox County is located in the Mississipian and Pennsylvanian Sandstone Groundwater Section of Indiana (Figure 4). This section is characterized by the fact that sandstone formations are the most widespread aquifers in the area. This is the only groundwater section in the state where sandstone aquifers are widespread and are used extensively (26).

Bedrock aquifers in Pennsylvanian sandstones are the principal source of groundwater in the upland areas of Knox County. These aquifers are used mainly for domestic and livestock water supply. Well depths in this region range from approximately 40 to 400 feet, with an average depth generally

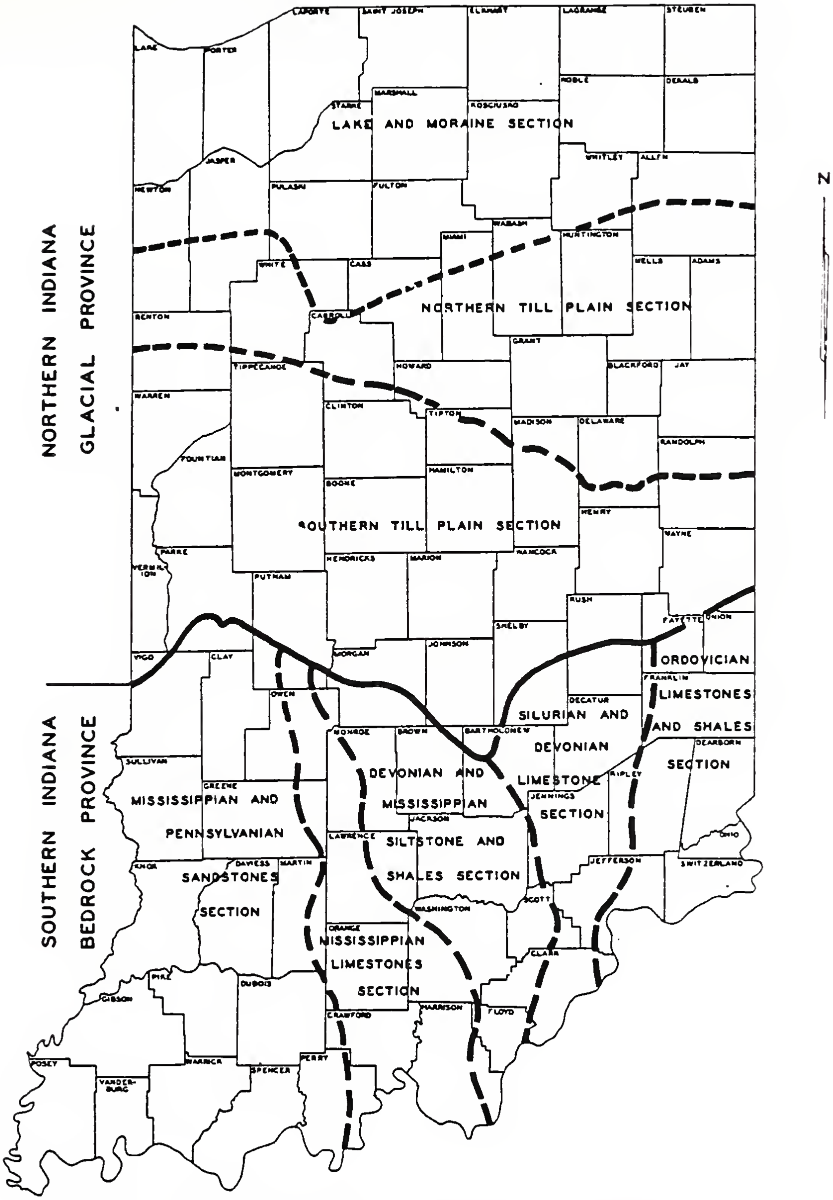


FIGURE 4. GROUNDWATER SECTIONS OF INDIANA (26).

less than 200 feet. The yields from these wells are usually less than 20 gallons per minute. In areas where groundwater yields are insufficient, constructed ponds provide the necessary water supply (2).

On the flood plains and outwash terraces along the Wabash and White Rivers the underlying sand and gravel provide the main source of groundwater. These unconfined aquifers yield several hundred gallons per minute. They provide the cities of Vincennes, Bicknell, Freelandville, Oaktown, Bruceville, Wheatland, and Sandborn with their water supply. Also, a county wide water system is being developed in some portions of the county (2).

PHYSIOGRAPHY

Knox County is located within the Wabash Lowland physiographic province of the State of Indiana as shown on Figure 5. In respect to its physiographic situation in the United States it is in the Till Plains section of the Central Lowland province (3).

TOPOGRAPHY

The surface of Knox County varies from broad nearly level flood plains, terraces, slackwater plains, and lacustrine plains along the Wabash and White Rivers to rolling, highly dissected sand and loess covered uplands in the central portion of the county. The general topography of Knox County is shown on Figure 6.

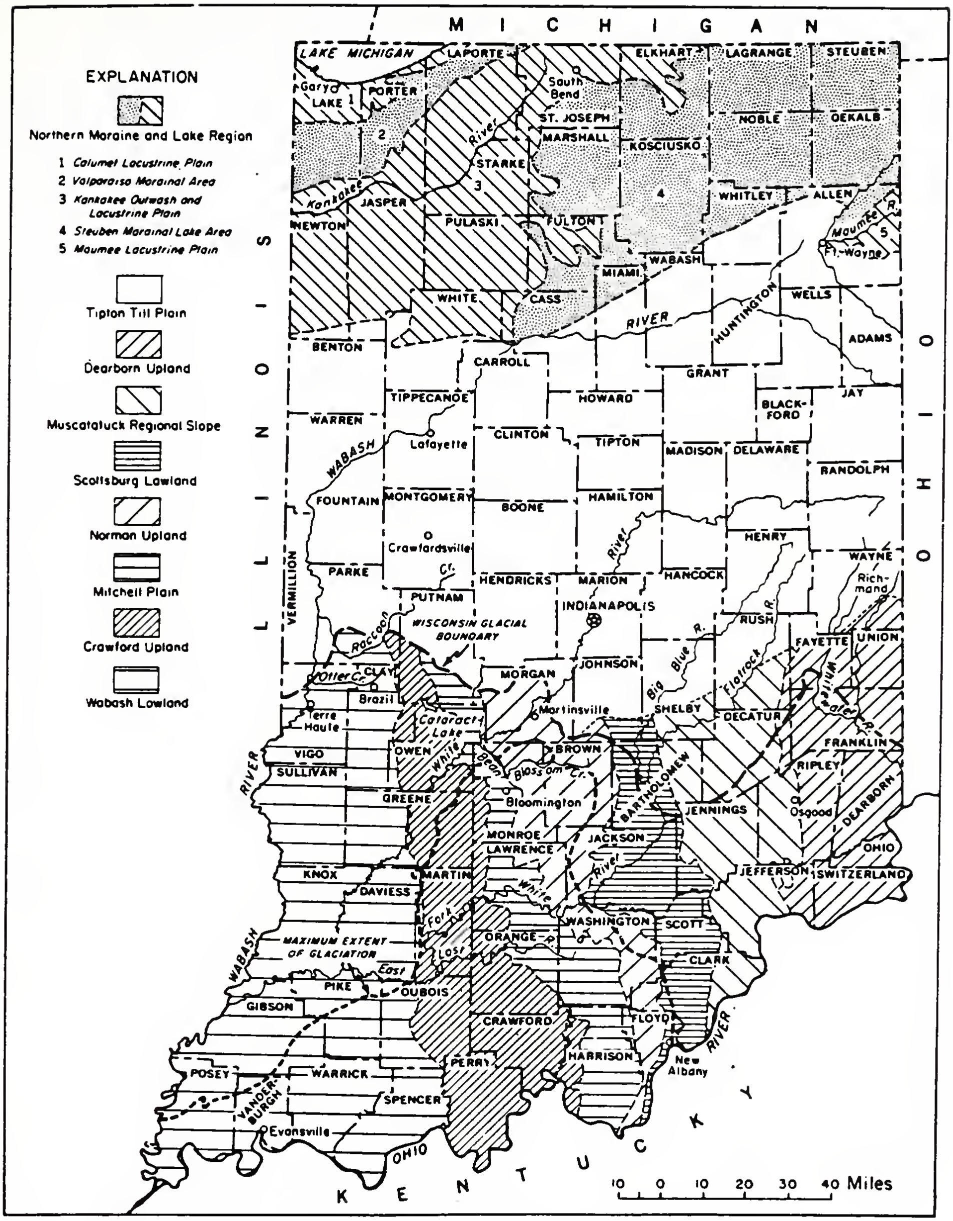


FIGURE 5. PHYSIOGRAPHIC UNITS AND GLACIAL BOUNDARIES IN INDIANA (40).

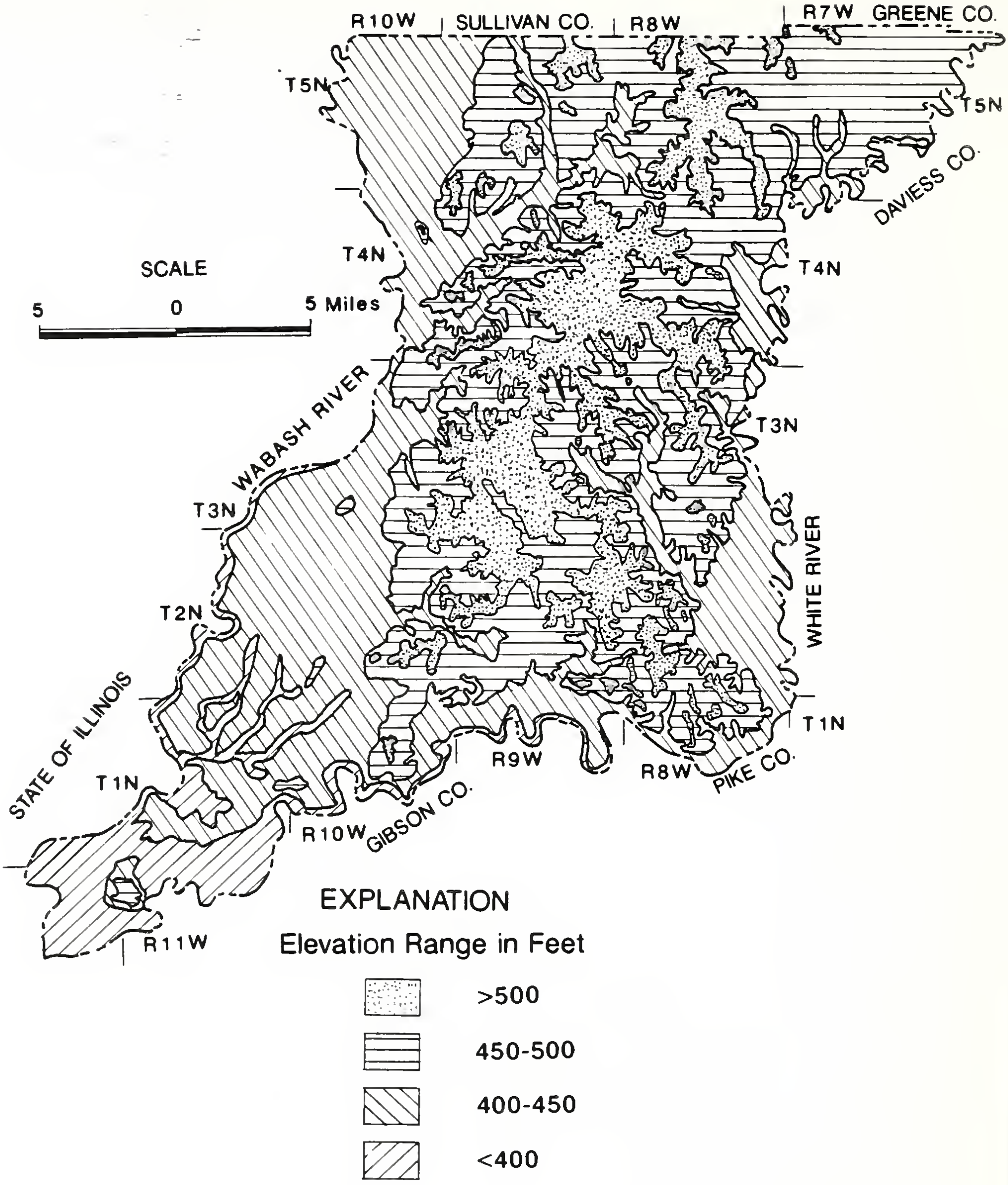


FIGURE 6. TOPOGRAPHY OF KNOX COUNTY (24).

The Wabash valley is wide and gently sloping with elevations less than 500 feet. The surface of outwash terrace remnants adjacent to the Wabash stand 425 to 430 feet above sea level at the northern edge of the county, and slope downstream with a gradient of approximately eight inches per mile, reaching an elevation of about 410 feet at the southern end of the county (12). Level flats are also located within the tributary valleys of the Wabash and White Rivers. The elevation of these lacustrine (slackwater) plains and terraces decrease downstream in successive tributaries in accordance with valley train filling and subsequent tributary ponding during Wisconsinan glaciation (13). Slackwater terraces associated with Busseron, Maria, Smalls, and Snapp Creek, tributaries of the Wabash from north to south, range in elevation from about 460 feet in the north to approximately 440 feet in the south (12). Slackwater plains in the tributaries of the White River are at a slightly higher altitude. Well developed plains are present at an elevation of 480 feet in the Black Creek Valley and 460 feet in the Indian Creek Valley to the south (13). The level topography of these flood plains, terraces, and slackwater plains is modified in numerous locations by loess and sand dune development.

An interesting topographic effect in Knox County is the presence of numerous partially buried bedrock hills that rise above the Wabash floodplain. These hills of circumnavigation (14) have survived the erosive fluvial and glacial forces which have removed the surrounding land. Table 6 gives the name, location, altitude above sea level, and the height relative to the surrounding flood plain of the larger hills of circumnavigation in Knox County.

TABLE 6. HILLS OF CIRCUMNAVIGATION IN KNOX COUNTY (15,16).

Name	Location	Altitude (feet)	Height (feet)
Wolf Hill	Sec 11,12; T4N; R10W	526	110
Bunker Hill	SW corner T3N, R10W	485	70
La Mamelle	Sec 27, T2N, R11W	423	15
Chimney Hills	Sec 29, T2N, R10W to Sec 6, T1N, R10W	500	90
Dicksburg Hills	West edge of T1N, R10W	540	150
Claypole Hills	NE corner T1N, R12W	500	80

The bedrock core of these hills is predominantly massive sandstone with the exception of Bunker Hill, which has a mostly shale core (15,16). However, the topographic expression of these hills is derived mainly from their mantle of loess and sand dune deposits, which on some is quite significant.

The central portion of Knox County consists of a rolling, dissected upland. Wind-blown sand deposits give the western part of the uplands a dunelike appearance. This region is generally absent of any stream dissection. The rest of the uplands, mantled mainly by loess, consist of gently rolling to rolling relief as the result of moderate stream dissection in these areas. The valleys are broad and U-shaped, with gently sloping sides. Areas of thorough dissection occur east of Bruceville, south of Bicknell, and southeast of Monroe City. In these locations, erosion is active, and the valley slopes are very steep (7). A few broad interstream divides occur in the areas of Freelandville and south of Bruceville (7).

The highest elevation in Knox County is 620 feet above sea level. It is located along State Highway 67 approximately three miles west of Bicknell in donation 122. The lowest is 376 feet above sea level and is located at the junction of the Wabash and White Rivers (2).

GEOLOGY OF KNOX COUNTY

The surface and near surface geology of Knox County consists of bedrock of Paleozoic age and unconsolidated materials of the Quaternary period. The bedrock lithologies are mainly sandstones and shales of Pennsylvanian Age. The Quaternary sediments were deposited by glacial processes during the Pleistocene Epoch and reworked by wind and water during that period and in Recent times.

BEDROCK GEOLOGY

Knox County lies within the Sullivan Lowland bedrock physiographic unit of the State of Indiana (3). The county is underlain by rocks of Pennsylvanian age (Figure 7) that generally strike northwest and dip southwest at 25 to 30 feet per mile into the Illinois Basin (Figure 8). A very generalized, east-west, geologic cross-section through Knox County is given as Figure 9.

The stratigraphy of the Pennsylvanian formations and coal members that underlie Knox County is shown on Figure 10. Also, the areal extent of the Pennsylvanian groups is shown on Figure 11.

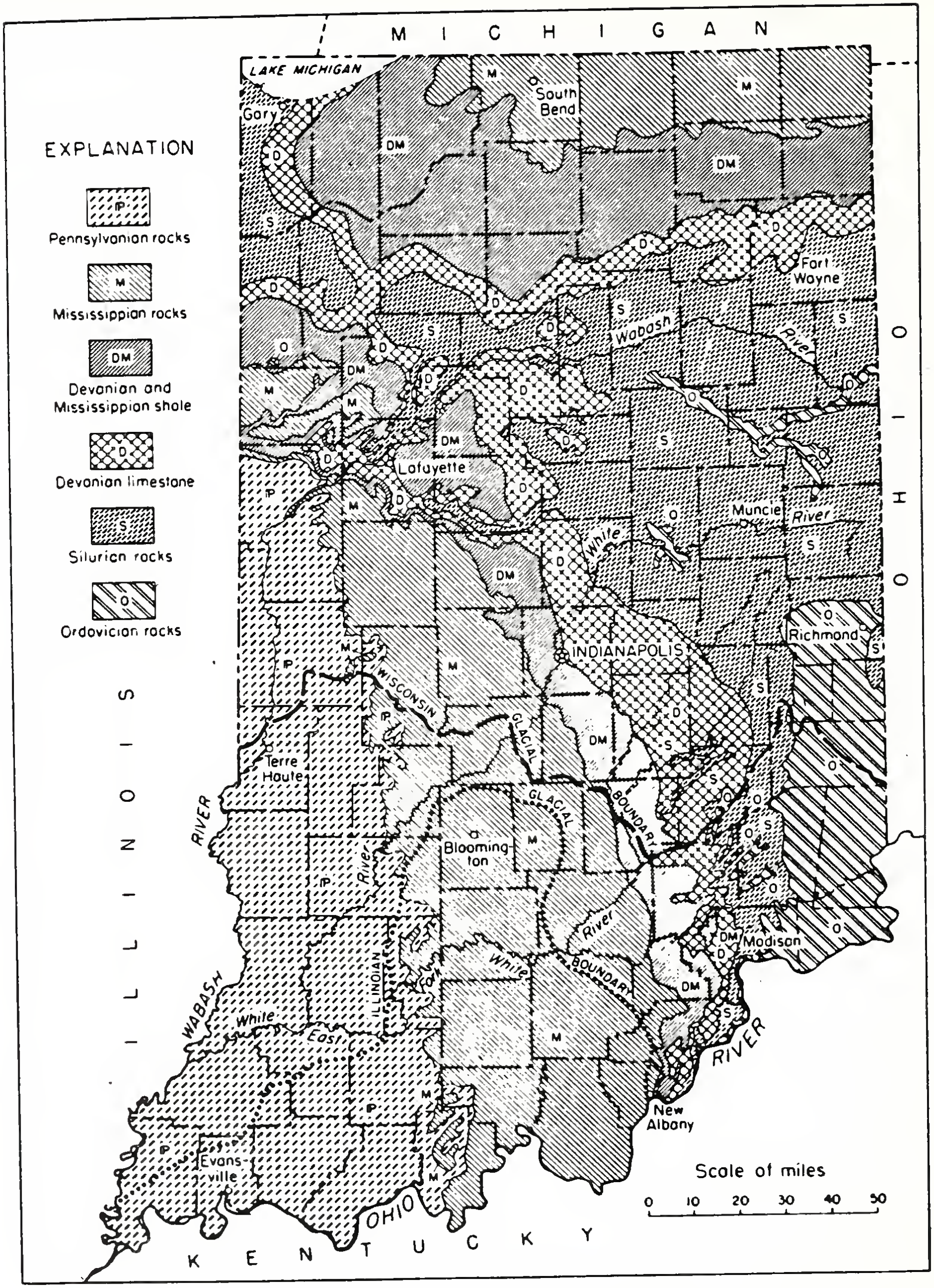


FIGURE 7. BEDROCK GEOLOGY OF INDIANA.

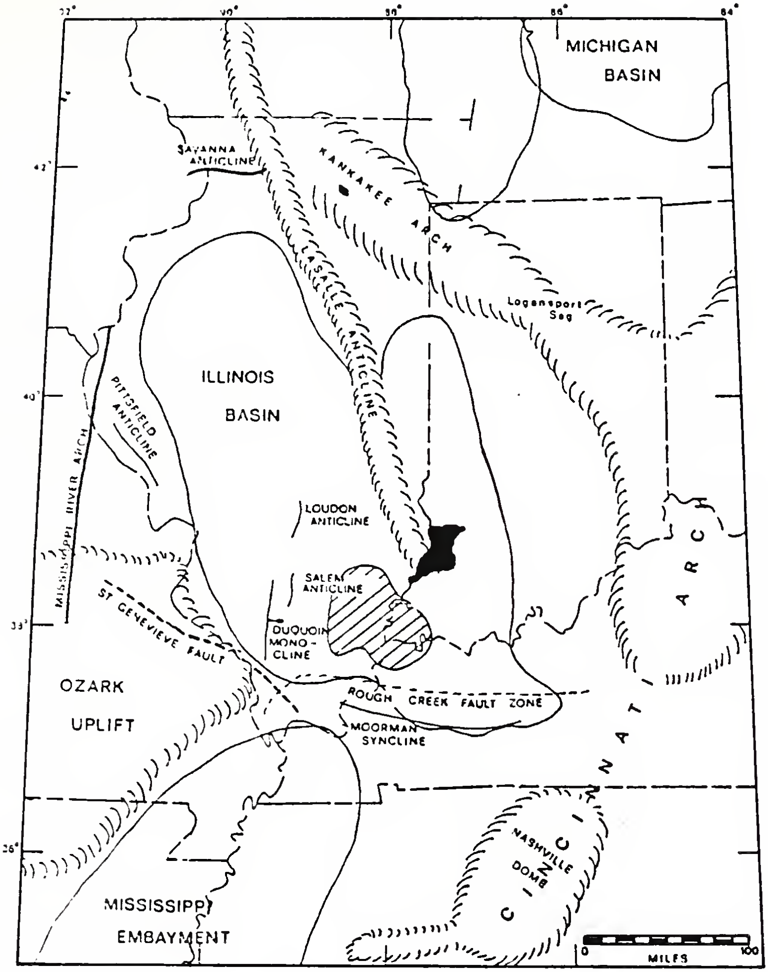


FIGURE 8. STRUCTURAL SETTING OF KNOX COUNTY.

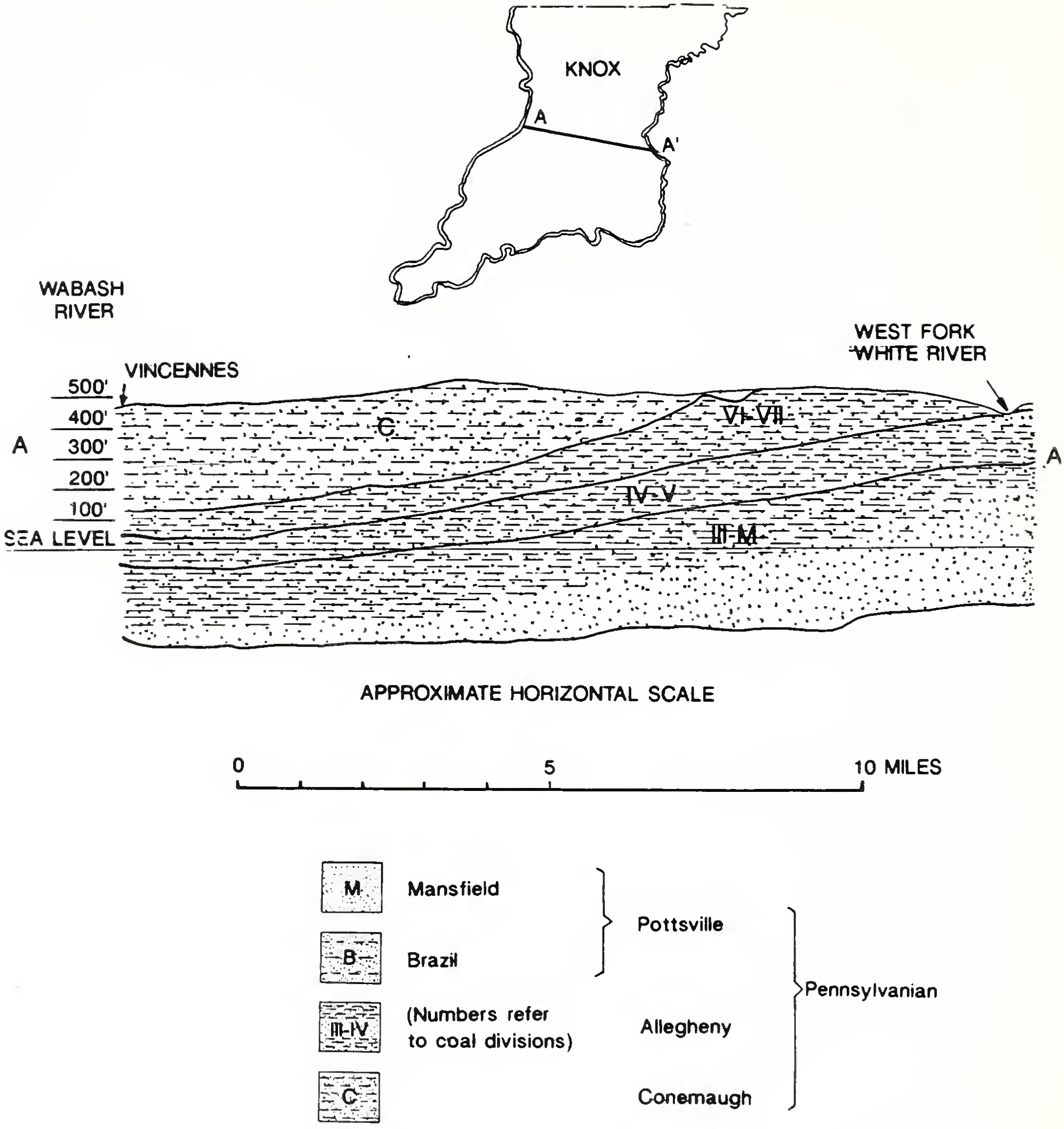
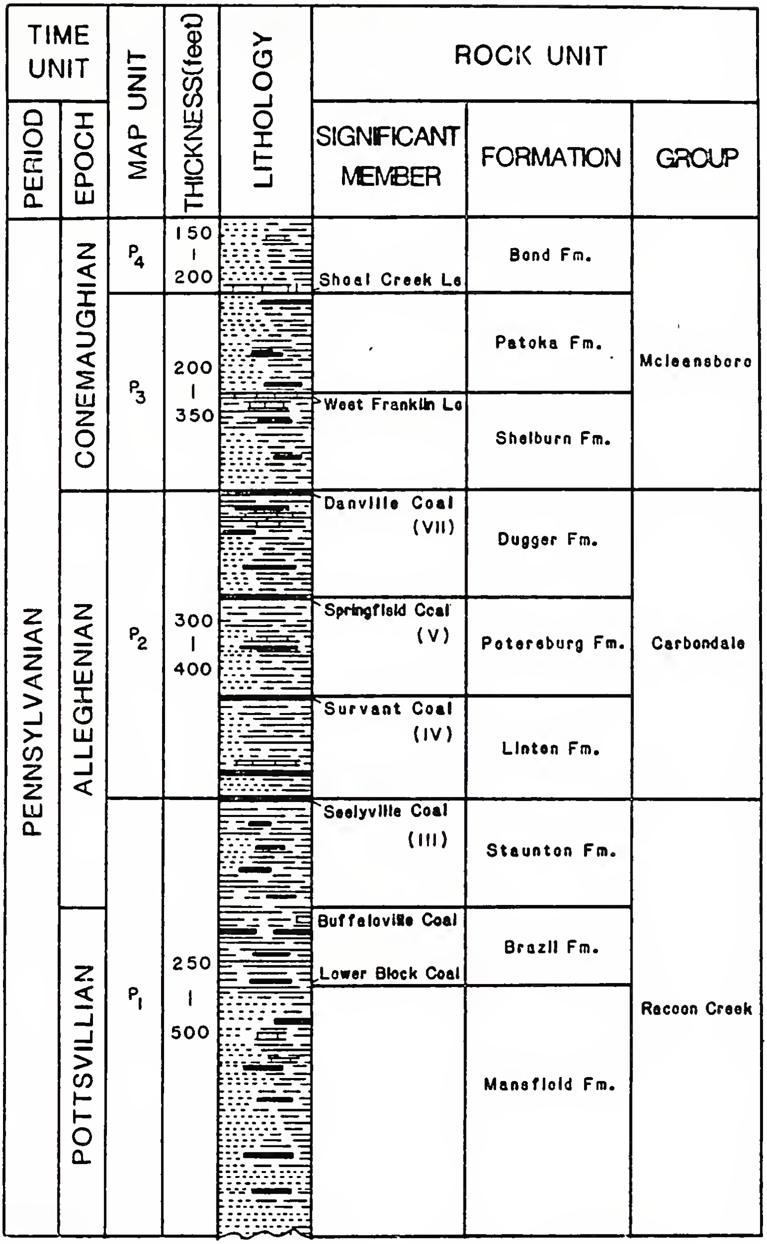


FIGURE 9. GENERALIZED GEOLOGIC CROSS-SECTION THROUGH KNOX COUNTY.



TIME UNIT		MAP UNIT	THICKNESS(feet)	LITHOLOGY	ROCK UNIT		
PERIOD	EPOCH				SIGNIFICANT MEMBER	FORMATION	GROUP
PENNSYLVANIAN	CONEMAUGHIAN	P_4	150 - 200		Shoal Creek Ls	Bond Fm.	Mcleansboro
		P_3	200 - 350			Patoka Fm.	
					West Franklin Ls	Shelburn Fm.	
	ALLEGHENIAN	P_2	300 - 400		Danville Coal (VII)	Dugger Fm.	Carbondale
					Springfield Coal (V)	Petersburg Fm.	
					Survant Coal (IV)	Linton Fm.	
		P_1	250 - 500		Seelyville Coal (III)	Staunton Fm.	Racoon Creek
	POTTSVILLIAN				Buffaloville Coal Lower Block Coal	Brazil Fm.	
						Mansfield Fm.	

FIGURE 10. COLUMNAR SECTION SHOWING BEDROCK STRATIGRAPHY OF KNOX COUNTY (22).

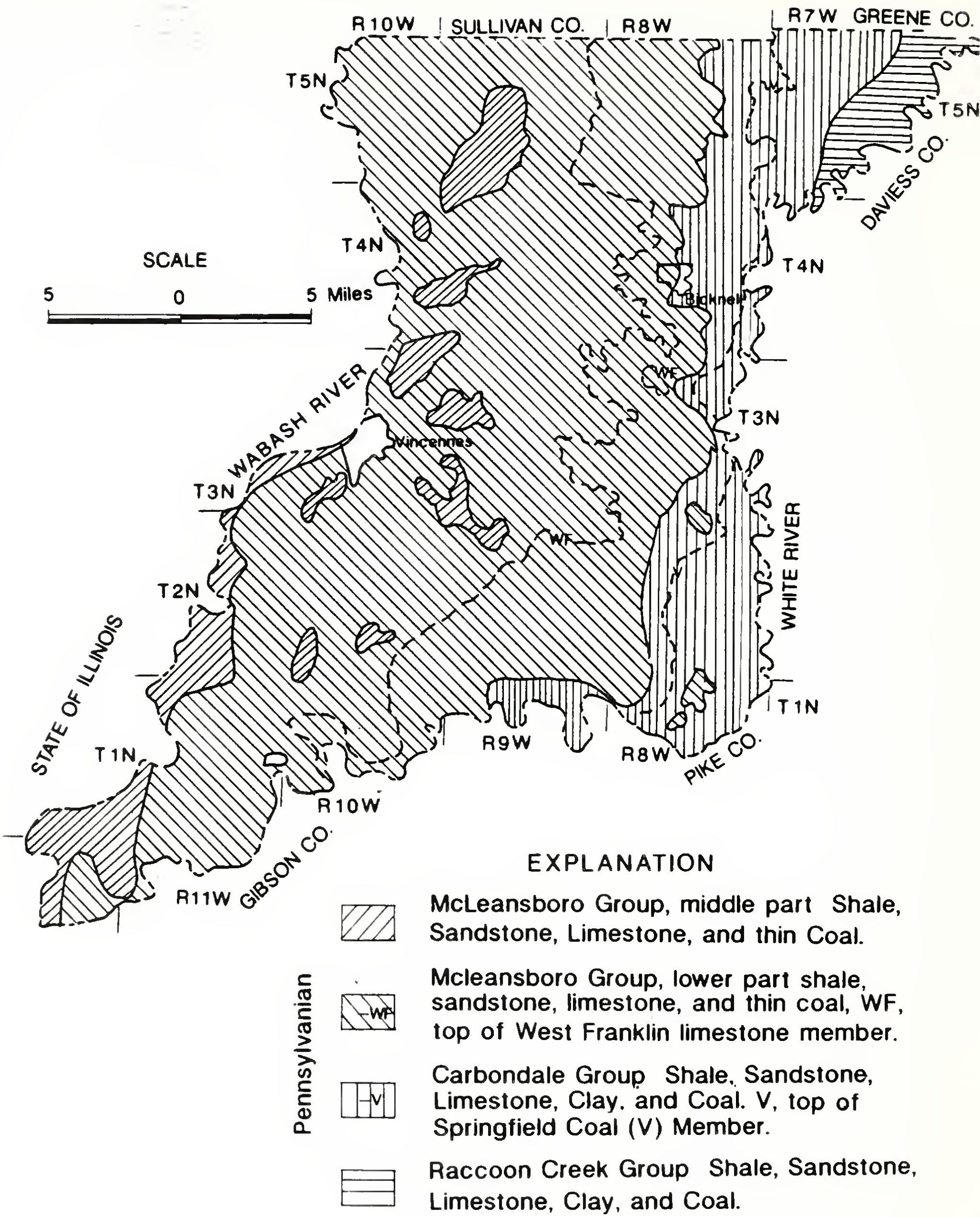

R10W
SULLIVAN CO.
R8W
R7W
GREENE CO.
T5N
T5N
DAVIESS CO.
T4N
T4N
SCALE
5
0
5 Miles
Bicknell
WF
WABASH RIVER
T3N
T3N
Vincennes
WF
T2N
WHITE RIVER
STATE OF ILLINOIS
T1N
T1N
R9W
R8W
PIKE CO.
R10W
R11W
GIBSON CO.
EXPLANATION
Pennsylvanian
McLeansboro Group, middle part Shale, Sandstone, Limestone, and thin Coal.
WF
Mcleansboro Group, lower part shale, sandstone, limestone, and thin coal, WF, top of West Franklin limestone member.
V
Carbondale Group Shale, Sandstone, Limestone, Clay, and Coal. V, top of Springfield Coal (V) Member.
Raccoon Creek Group Shale, Sandstone, Limestone, Clay, and Coal.

FIGURE 11. BEDROCK GEOLOGY OF KNOX COUNTY (22).

The McLeansboro Group consists mainly of shale, sandstone, and minor amounts of siltstone, limestone, clay, and coal (17). The Carbondale Group is a variable sequence of sandstone, shale, limestone, and coal. The commercial coal beds in Knox County are found in this group (17). The Springfield Coal Member (V), the top of which is traced on Figure 11 , provides much of the strip-mined coal in the northeast part of the county. Shale and sandstone dominate the lithology of the Raccoon Creek Group. Clay, coal, limestone, chert, and sedimentary iron deposits are also present in small amounts (17).

Outcropping rock is not common in Knox County; however, rock forms the beds in some streams and is nearly always exposed near the base of the hills of circumnavigation. These outcrops consist mainly of thick-bedded, resistant sandstone. A thick-bedded upper Pennsylvanian sandstone is exposed in a road cut on US 41 at Maria creek (16).

The Dicksburg Hills Sandstone Member (Patoka Formation of McLeansboro Group) is exposed in the Dicksburg Hills in the SW 1/4 sec 18, T1N, R10W. It is a massive, fine to coarse grained, cross-bedded sandstone containing quartz and clay pebbles. The sandstone at Dicksburg Hills is 50 feet thick (17). Also, Shaver (17) reports that the St. Wendel Sandstone Member (Bond Formation of McLeansboro Group) outcrops in the bluffs adjacent to the Wabash in Knox County. This rock unit is a medium-grained, micaceous, massive sandstone commonly ranging from 45 to 55 feet in thickness (17).

Stratigraphic correlations between isolated sandstone outcrops is difficult as some of the thick sandstones grade laterally into sandy shale (17). The Meron Sandstone (Matton Formation of McLeansboro Group), for example, has been incorrectly correlated with numerous outcrops in the county. According to Shaver (17), many workers have called the Inglefield Sandstone Member (Patoka Formation of McLeansboro Group) and some higher sandstones in the county the Meron.

There are some small limestone quarries in the northeastern part of the county, but the beds are thin and the stripping heavy. Also, some limestone is located in the north-central portion of the county; the most extensive quarry is in sec 21, T4N, R8W, 2nd PM. It has four feet of hard limestone (4).

The general bedrock topography of Knox County is illustrated in Figure 12. Bedrock exhibits the highest elevation, greater than 550 feet above mean sea level, in the central portion of the county and the lowest, less than 300 feet, in the lower Wabash and White River Valleys.

PLEISTOCENE GEOLOGY

Illinoian ice advanced through Knox County filling pre-Illinoian valleys with drift and incorporating the area into a large flat till plain (12). The central upland region of the county is a remnant of this relatively flat glacial plain; however, today it is quite dissected and obscured by loess deposits. Illinoian till in Knox County is exposed only on very small isolated upland remnants.

Lacustrine and eolian deposition during this period existed in the region but was either not pronounced, or has been eroded in Knox County.

Withdrawal of the Illinoian glacier marked the start of the Sangamon

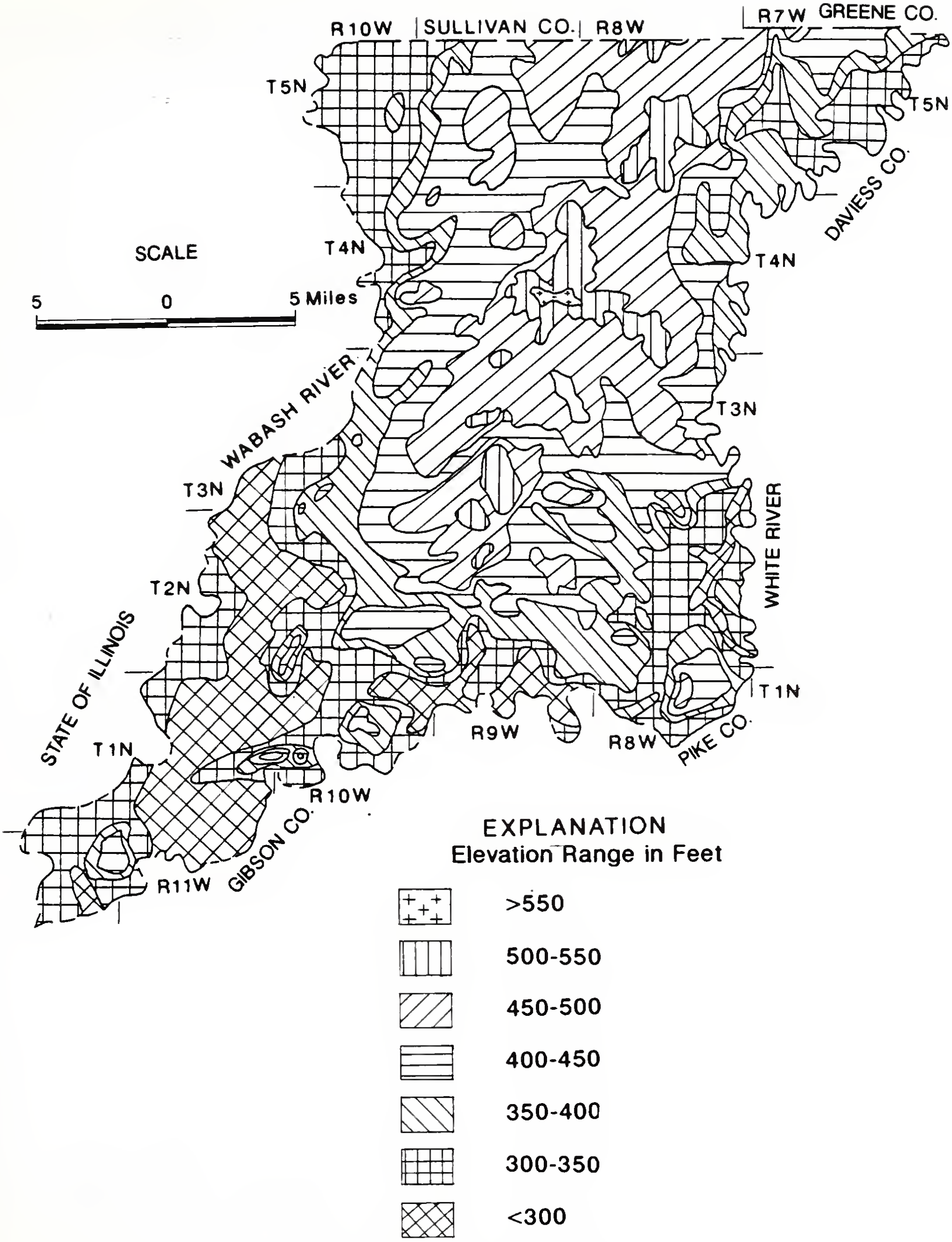


FIGURE 12. TOPOGRAPHY OF BEDROCK SURFACE IN KNOX COUNTY (18).

interglacial stage of erosion and weathering. During this time the Wabash and White Rivers were once again developed on the till plain above their buried valleys because of differential compaction of the glacial drift (16). Also, small consequent valleys were developed on the gentle, southward-sloping glacial plain. The till was eventually removed to or nearly to the bedrock floors of the preglacial Wabash and White drainage systems. Till above bedrock valley floors has not been recognized in many well records in the county (16). Such widespread and deep erosion was probably the result of minor regional uplift or rebound of the earth's crust after the ice had been removed.

The Sangamon interglacial stage was also a time of minor eolian deposition in the region; however, nearly all evidence of these deposits have been removed by erosion in Knox County (16).

Following the Sangamon stage, Knox County was approached by continental glaciers of Wisconsinan age. The county was not covered by Wisconsinan ice; however, as the glaciers advanced upon the region from the north, the Wabash and White River Valleys served as sluiceways for melt waters from the ice front. The melt waters carried great volumes of detritus derived from country rock and Illinoian till from the north. This detritus was dropped ahead of the ice in the Wabash and White Valleys creating extensive valley train deposits (13).

At the maximum extension of the ice in Wisconsinan time, the terminus of the glacier was about 45 miles north of the northern border of Knox County as shown on Figure 5. At this time, valley-filling reached its maximum, and portions of the old uplands were completely buried beneath the valley train materials (12).

As the ice again withdrew to the north, melt waters continued to discharge down the major valleys in the county; however, the greater part of their detrital load was north of the Shelbyville terminal moraine (12). The surface of the maximum valley-fill in Wisconsinan time, when the ice sat at the Shelbyville moraine, is called the Shelbyville terrace. Remnants of the Shelbyville terrace surface exist in northern Knox County where they are associated with high-level fluves that isolate upland tracts in the Wabash Valley (16).

The valley trains were built down the sluiceways of the Wabash and White Rivers so rapidly that their tributary streams could not keep pace in building their floors. As a result, the tributary valleys were ponded, and an extensive system of lakes was formed. These lakes are represented by lacustrine (slackwater) plains whose levels coincide closely with the altitude of the valley train which occupied the adjacent sluiceway (12). Some of these lacustrine deposits have been eroded as the tributaries regained their flood plains, resulting in slackwater terrace surfaces. Figure 13 is a block diagram that shows the general relation between these slackwater deposits, outwash deposits, and recent stream deposits.

Also during valley-filling, as the floor of the Wabash was constructed increasingly higher, the river occasionally spilled over lower places in upland spurs between tributaries of the main valley, removing residual material and wearing down the bedrock of the newly selected route (12). The result was isolated bedrock highs within the sluiceway. These hills of circumnavigation are listed in Table 6.

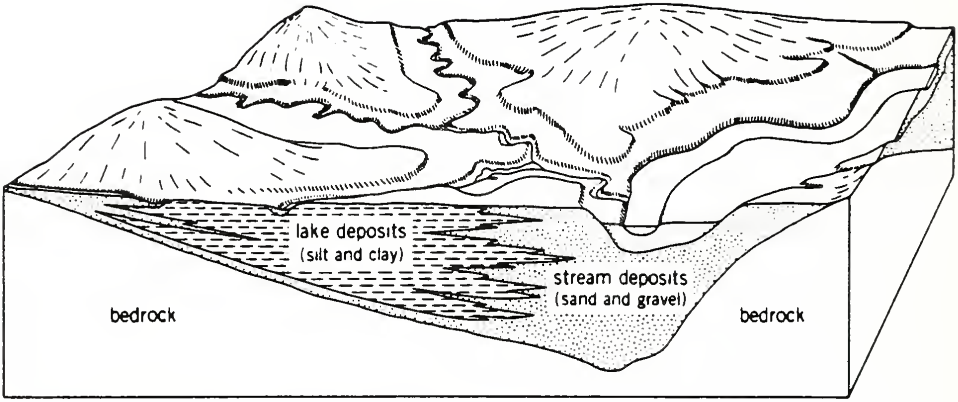


FIGURE 13. Block diagram showing relation of lake deposits to tributary valleys, glacial outwash (sand and gravel) in main valley, and associated stream deposits. Diagram does not show a specific place but incorporates many features typical of lake deposits and terraces that they form. Width of block about 10 miles; depth of block about 200 feet. (19).

Following the withdrawal of the Wisconsinan ice sheet to the northeast from the Shelbyville moraine, another terrace level was developed along the Wabash, leaving the Shelbyville surfaces as high terraces in the county. Fidler applied the name Maumee to this erosional terrace because he believed that it developed during the time that the Wabash Valley was the outlet for the overflow waters of Glacial Lake Maumee, the ancestor of Lake Erie (16).

Since its development in late Wisconsin time, the Maumee terrace level has been eroded to a large extent in Knox County by the development of a very expansive Wabash flood plain. However, there are many remnants of the Maumee terrace extending along the Wabash from Vincennes to the White River. These vary in size and are often highly dissected by flood plain fluves. The city of Vincennes is built partially upon a large remnant of the Maumee terrace (16).

Throughout Wisconsinan and Illinoian time in Knox County, prevailing westerly winds have picked up sand and silt from the Wabash valley train and have deposited them on the uplands to the east (20). The sand was blown relatively short distances, but the silt was deposited over a much larger area.

Sand dunes are scattered throughout Knox County. They are most prominant on the terrace surfaces in the northern part of the county, and on the bluffs of the Wabash south of Vincennes. Nearly all the upland areas of the county are covered by deep loess deposits. Also, dunes and loess mantle all the hills of circumnavigation.

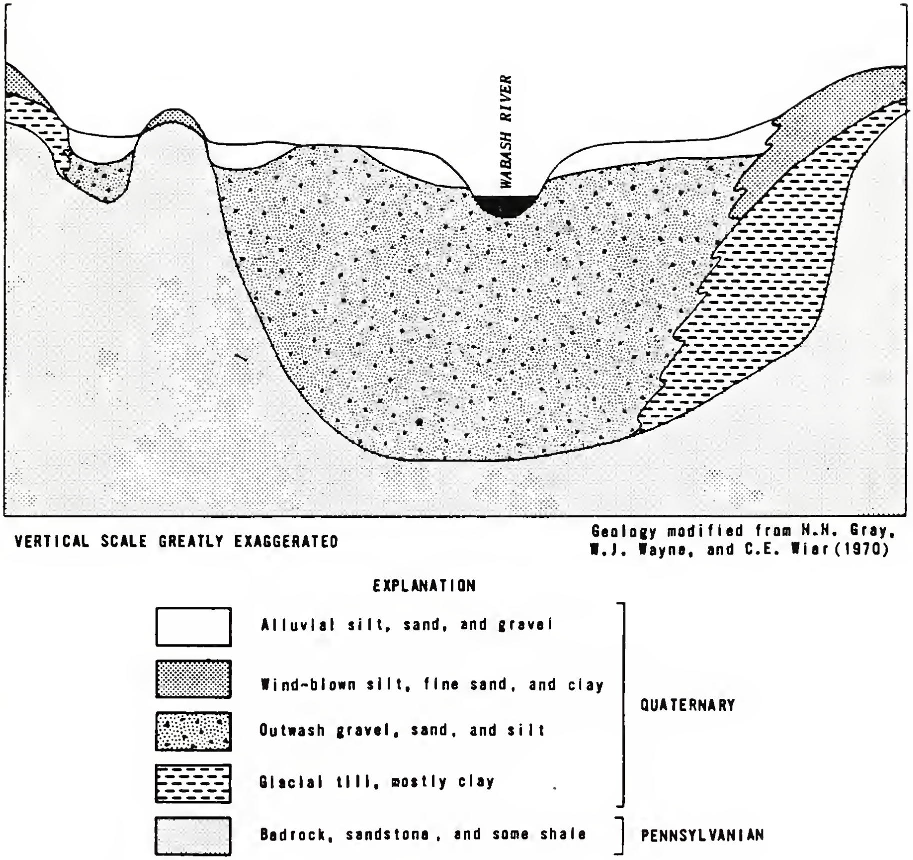
Since the Maumee erosional period, seasonal floods and lateral erosion of the meandering Wabash and White Rivers have resulted in their present wide flood plains and alluvial deposition. Also, their channels are presently shifting locally leaving many abandoned meanders and channel scars.

Figure 14 is a schematic cross-section showing the general geometry of the unconsolidated deposits in the Wabash River valley. East and west are not labeled as the figure illustrates relations that exist on both sides of the valley. Figure 15 illustrates the general distribution of the different types of unconsolidated deposits in Knox County, and Figure 16 shows their approximate thickness. The thickest deposits of unconsolidated material are found in the southeast corner of the county, while the drift is thinnest in the central and northern regions.

LANDFORM-PARENT MATERIAL REGIONS

The engineering soils in Knox County are derived primarily from unconsolidated material. These materials are classified according to parent material and landform in the following section. Seven parent material units are mapped in the county. They are: eolian drift, lacustrine drift, fluvial drift, glacial-fluvial drift, cumulose drift, and mined land. The parent materials are further divided into individual landforms for discussion purposes.

Each landform-parent material region is characterized by its overall extent, surface morphology and character, and general soil profile. Soils


WABASH RIVER
VERTICAL SCALE GREATLY EXAGGERATED
EXPLANATION
Alluvial silt, sand, and gravel
Wind-blown silt, fine sand, and clay
Outwash gravel, sand, and silt
Glacial till, mostly clay
Bedrock, sandstone, and some shale
QUATERNARY
PENNSYLVANIAN

Geology modified from H.H. Gray, W.J. Wayne, and C.E. Wier (1970)

FIGURE 14. GENERALIZED CROSS-SECTION OF THE WABASH RIVER VALLEY (21).

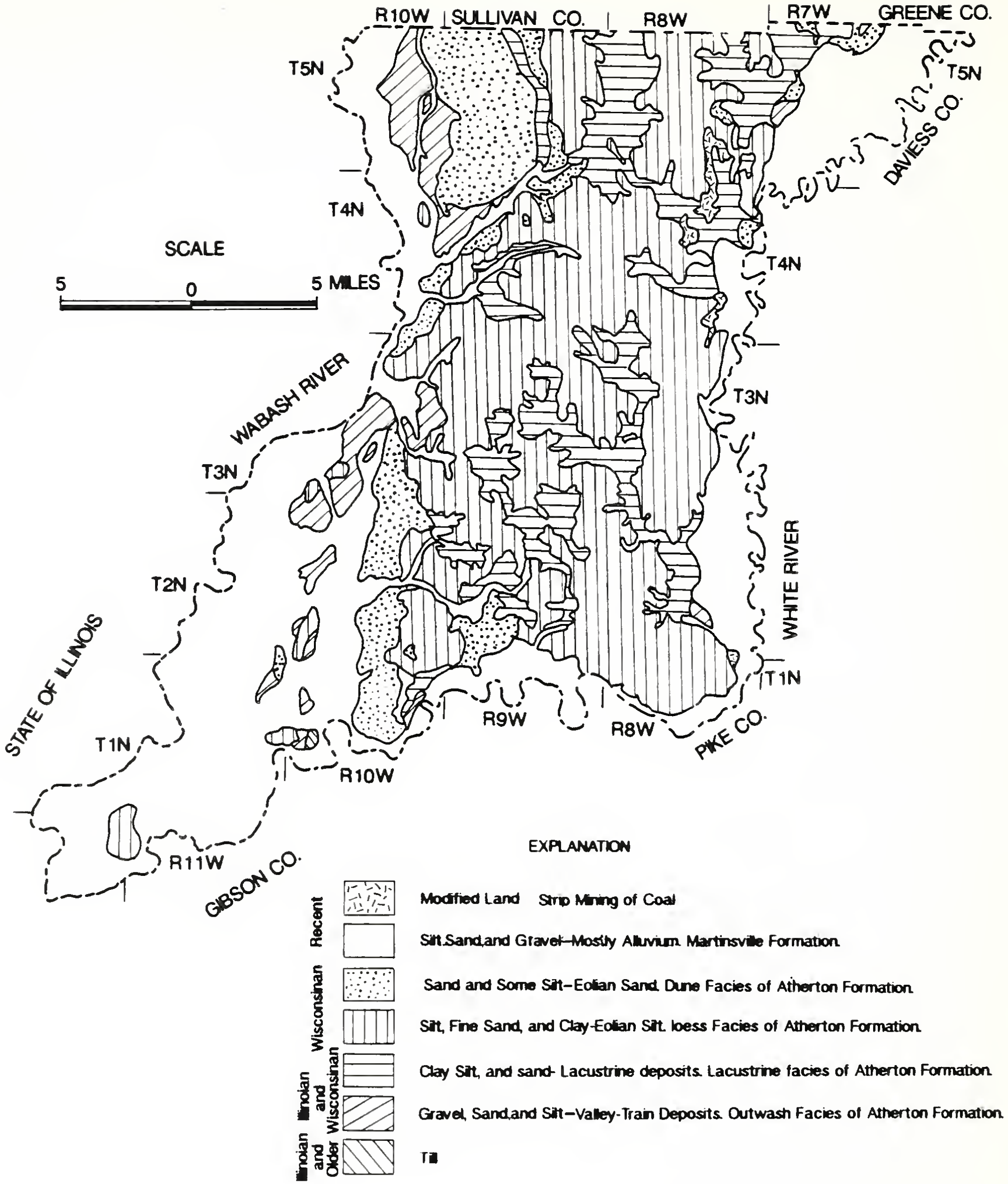

R10W
SULLIVAN CO.
R8W
R7W
GREENE CO.
T5N
T5N
DAVIESS CO.
T4N
T4N
SCALE
5
0
5 MILES
WABASH RIVER
T3N
T3N
T2N
STATE OF ILLINOIS
T1N
T1N
WHITE RIVER
R9W
R8W
PIKE CO.
R10W
R11W
GIBSON CO.
EXPLANATION
Recent
Wisconsinan
Illinoian and Wisconsinan
Illinoian and Older
Modified Land Strip Mining of Coal
Silt,Sand,and Gravel–Mostly Alluvium. Martinsville Formation.
Sand and Some Silt–Eolian Sand. Dune Facies of Atherton Formation.
Silt, Fine Sand, and Clay-Eolian Silt. loess Facies of Atherton Formation.
Clay Silt, and sand- Lacustrine deposits. Lacustrine facies of Atherton Formation.
Gravel, Sand,and Silt–Valley-Train Deposits. Outwash Facies of Atherton Formation.
Till

FIGURE 15. UNCONSOLIDATED DEPOSITS OF KNOX COUNTY (22).

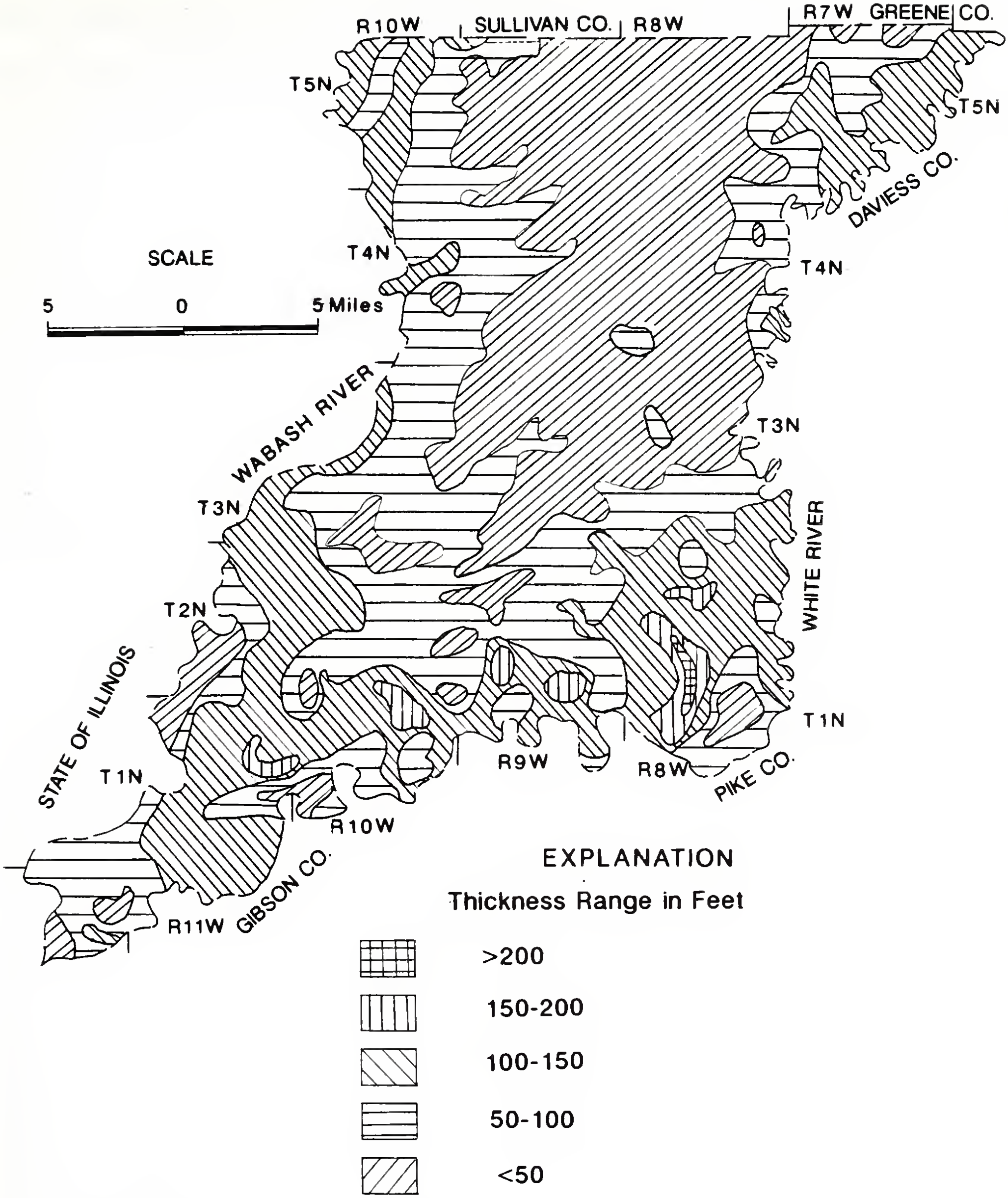


FIGURE 16. THICKNESS OF UNCONSOLIDATED DEPOSITS IN KNOX COUNTY (23).

are classified in the profile description using both the United States Department of Agriculture textural designation, i.e. silt loam, and the American Association of State Highway Officials (AASHTO) system, i.e. A-6. Also, the agricultural soils that form in each unit are given. The physical, chemical, and engineering index properties of these soils are presented in Appendices B and C. Boring numbers, which correlate to the classification test results given in Appendix A, are also stated for each soil unit.

Engineering considerations for each parent material region are discussed also. This section gives the investigator a general idea of the material behavior and possible problems encountered within each landform-parent material region.

EOLIAN DRIFT

Eolian (wind deposited) drift is the predominant parent material found in Knox County. These deposits of loess and sand were deposited mainly during Wisconsinan glaciation. Extensive loess deposits cover nearly all the upland areas in the county, while sand dunes are most prominant on the bluffs adjacent to the Wabash Valley. In these upland locations there is a fairly well-defined division between the sand and the loess, however, in some areas near their contact, a thin veneer of sand may extend over the loess. These deep eolian deposits nearly always overlie clayey Illinoian drift. Wind-blown sand with incipient dune development is also prominant on outwash terraces along the Wabash River, and scattered dunes are developed throughout the lowlands. Loess is found covering slackwater deposits in the northern part of the county, and dunes and/or loess mantle all the hills of circumnavigation.

The thickness of loess deposits in Knox County is illustrated by Figure 17. This figure shows isothickness lines and measurement locations of total loess thickness, in inches, based on investigations by Fehrenbacher (21). Appendix F catalogues the location, thickness of the loess, and a description of the underlying material for each measurement point on Figure 17. These data show that the thickest deposits, of over 250 inches, are found adjacent to the Wabash Valley. The loess tends to decrease in thickness towards the east, however, some variation does exist. Loess appears to be the thinnest in the very central portion of the county as shown by measurement locations 37, 38, and 39. Here 54 to 72 inches of loess overlie Illinoian till.

Eolian deposits are subdivided into six engineering soil units according to their relative depth and underlying materials. The subdivisions are: loess plain, loess over slackwater plain, loess over sandstone-shale bedrock, sand dunes, sand with incipient dune development, and sand dunes over sandstone-shale bedrock.

Loess Plain

The largest portion of Knox County is mapped as loess plain. In this region loess is found mantling Illinoian drift, which rests on interbedded sandstones and shales, to an average depth of 120 inches. Most of the Illinoian deposits are from 20 to 25 feet in thickness, but are very thin in many places (25). The landform is rolling and highly dissected. This

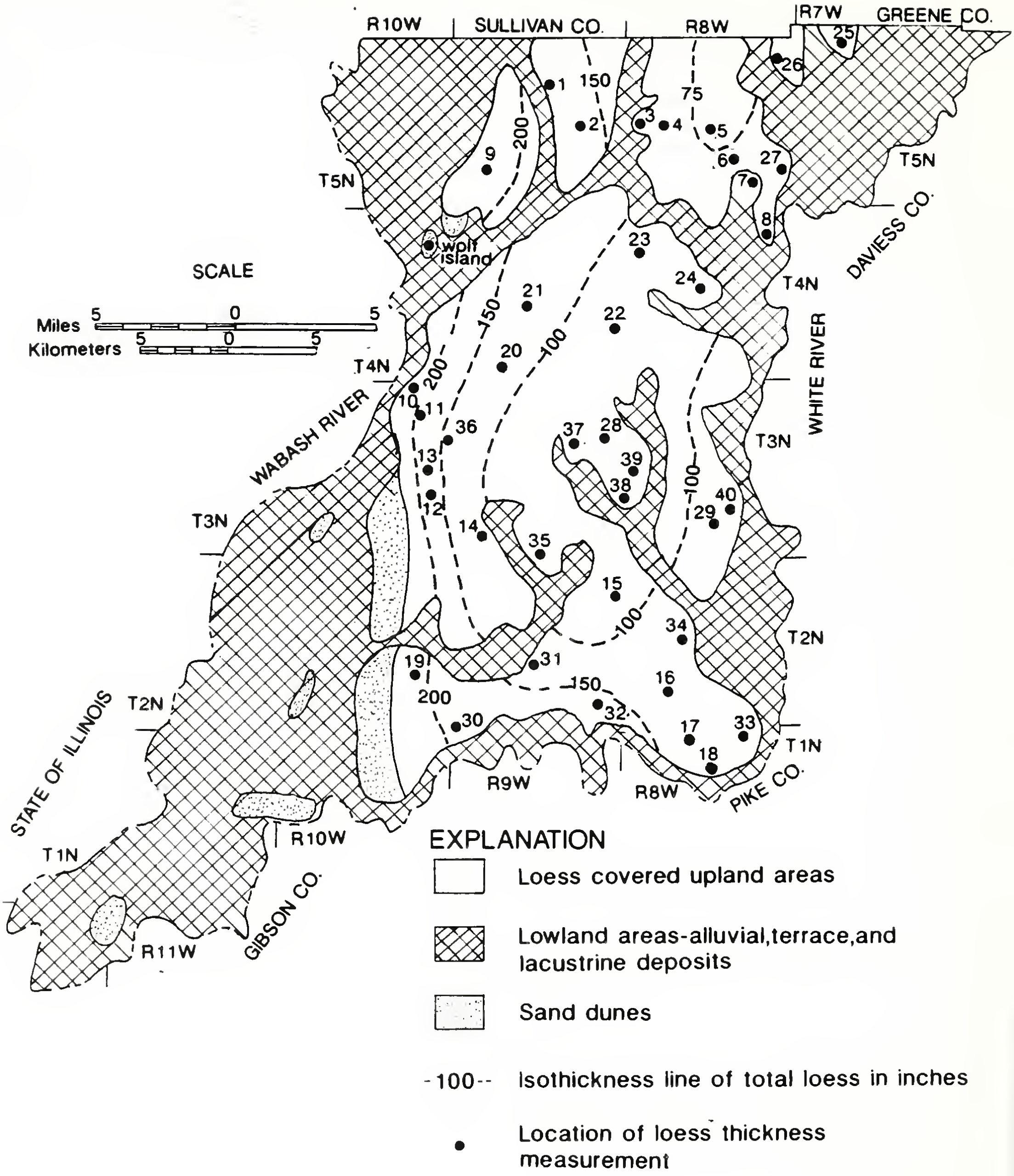


FIGURE 17. LOESS THICKNESS MAP OF KNOX COUNTY (20).

suggests the presence of the underlying rock, however, the distance between gullies is somewhat greater than what would be expected in an area where loess mantles sandstone and shale alone. Also, Fehrenbacher's data (Appendix F) shows only a few instances where bedrock residuum was found directly underlying loess in this region.

Deep gullies in this region usually exhibit heavy tree growth and produce a dendritic pattern. The typical pinnate or feather-like drainage pattern associated with deep loess is developed only occasionally. Gullies are usually U-shaped with generally low gradients.

The surface soils, to a depth of 10 to 30 inches, consist mainly of silt loam (A-4, A-6). This soil is of low placticity (PI 5-15). The subsoil, to a depth of 24 to 70 inches, is more plastic (PI 15-30) and is usually silt loam or silty clay loam (A-6 to A-7). The underlying material is silt loam (A-4, A-6), which grades into clayey Illinoian till.

The agricultural soils formed on these upland loess deposits are the Alford, Hosmer, Iva, and Sylvan series. The physical, chemical, and engineering index properties of these soils are given in Appendix B.

Boring numbers 12, 80, 88, 89, and 113 to 115 (Appendix A) are located in the loess plain region.

Loess over Slackwater Plain

The areas of loess over slackwater plain are located in the north-central part of the county. These poorly drained areas are a transition zone between the slackwater plains and the adjacent loess covered uplands.

The surface is nearly level to slightly undulating. Surface drainage is not well developed, and in places ditches are used to facilitate the draining of surface water. The boundary between this area and the adjacent upland is marked by an abrupt change of elevation and a change in the topography of the surface. The loess cover in these areas is typically about 6 to 7 feet, with the soil profile developed predominantly in the loess.

The surface soils, to a depth of 12 to 24 inches, consist mainly of silt loam (A-4, A-6) or silty clay loam (A-6, A-7). The subsoil, to a depth of 24 to 60 inches, contains more clay and is classified as silty clay loam (A-6, A-7), silty clay (A-7), or clay (A-7). The underlying material is a silt loam (A-4, A-6) or silty clay loam (A-6, A-7), with stratified silt loam and/or silty clay loam and/or clay occurring further down.

The agricultural soils formed in areas of loess over slackwater plain are the Reesville and Ragsdale series.

Loess over Sandstone-Shale Bedrock

The areas classified as loess over sandstone and shale bedrock are confined to isolated hills within the Wabash Valley. These hills of circumnavigation generally contain no glacial evidence between their loess mantle and the underlying rock. The only exception to this appears to be the Dicksburg Hills, which contains some Illinoian drift (9). The topography of these hills is typically rugged and highly dissected. The thickness of the loess ranges from about 48 to over 200 inches. Sand dunes often occur in association with the loess. They generally form at a lower elevation on the hills and often encroach upon the loess.

The soil profile is developed mainly from the loess, however, in some locations it forms in weathered sandstone and shale. The surface of these well drained soils, to a depth of 12 to 48 inches, is silt loam (A-4, A-6). The subsoil, to a depth of 36 to 72 inches, is mainly silt loam or silty clay loam (A-6, A-7). The underlying material is a silt loam (A-4, A-6) with sandstone fragments near the bedrock contact. The bedrock underlying these hills is generally massive sandstone with some interbedded shale.

The agricultural soils that characterize the loess over sandstone-shale areas include the Alford, Iva, and Sylvan series.

Sand Dunes

A wide band of sand dunes exists on the bluffs adjacent to the Wabash Valley, and scattered dunes also occur on slackwater and flood plains. The upland dunes show variable relief ranging from about five to 50 feet high. These deposits generally overlie clayey Illinoian drift; however, in some locations they may mantle loess deposits. The individual dunes formed on the slackwater and flood plains are lower, usually less than 15 feet high.

Surface drainage systems are absent in these hummocky sand dune regions. However, infiltration basins are observed in the inter-dune areas. These darker interdunal basins create a speckled appearance on the aerial photographs. A few short, steep gullies are sparsely developed along the edge of the dunes where the difference in elevation is great between the adjacent land. Also, gully development is prominant at the sand dune-loess contact.

The composition of the sand dune material is predominantly fine, uniform, windblown sand. However, small amounts of silt and clay particles are mixed with the sand near the surface. Lateral and vertical variations in composition are also observed in these areas. The surface soils are usually fine sand (A-3) or loamy fine sand (A-2-4). The subsoil consists mainly of fine sand (A-3), sandy loam (A-4), and sandy clay loam (A-6). The underlying material is most often fine sands and loamy fine sands. In some locations the water table is high and surface ponding is favorable. In these areas the surface soils have a higher organic content.

The agricultural soils that form in upland dune areas are the Alvin, Bloomfield, and Ayrshire series.

Boring numbers 2 and 4 are located in this region.

Sand with Incipient Dune Development

Windblown sand with scattered dune development is found on nearly half of the outwash terraces in the Wabash and White Valleys. This landform is particularly prominant when outwash remnants are located adjacent to the upland sand dune region. The sand dunes scattered on these surfaces are well formed but usually are low in magnitude (most are less than 10 feet high). The thickness of these deposits is mainly from 54 to 84 inches.

Surface drainage is absent on these undulating sand covered terraces, however, some current scars and infiltration basins are observed.

The soil profile is these areas is formed in the eolian sand and to a smaller degree in the underlying outwash deposits. The surface soil is a fine sandy loam (A-4, A-6). The subsoil may contain some clay and is classified as a fine sandy loam (A-4, A-6), fine sand (A-3), or sandy clay loam (A-6). The subsurface soil is generally fine sandy loam, which grades into stratified fine sandy loam and gravelly sand.

The agricultural soils that develop in these regions include the Ayrshire, Bloomfield, and Chelsea series.

Boring numbers 5-11, 18, and 84 are located in areas of sand with incipient dune development over outwash terraces.

Sand Dunes over Sandstone-Shale Bedrock

The areas classified as sand dunes over sandstone-shale bedrock are confined to the hills of circumnavigation. These deposits can be quite deep. The thickness of sand dunes on Chimney Hills is as great as 50 feet in some locations (15). However, in most locations 36 to 120 inches of sand mantle the underlying sandstone-shale bedrock.

When these deposits are found in association with loess, they are generally at a lower elevation and may interfinger with, or encroach upon, the loess. The relative thickness of the sand and loess in these areas can vary greatly.

Surface drainage is usually absent, however, some gullies initiated in the higher loess may continue slightly into these deposits. The topography of the hills is generally rugged indicating the presence of the underlying bedrock.

The surface soils are mainly fine sandy loam (A-4, A-6) and fine sand (A-3). The subsoil can be silty in nature and is classified as a fine sandy loam or silt loam (A-4, A-6). Fine sand with sandstone and shale fragments is usually found before bedrock is encountered. As mentioned previously, the bedrock underlying these hills of circumnavigation is generally massive sandstone with some shale interbeds.

The agricultural soils that form in these areas are the Alvin and Bloomfield series.

Engineering Considerations in Eolian Drift

Unweathered loess is poorly cohesive and has a high porosity and permeability (vertical > horizontal), while weathered loess is slightly plastic and less permeable. Loess is usually classified using the Unified system as ML, ML-CL, or CL material.

At natural moisture contents loess has a relatively high strength, as well as low compressibility, because of partial cementation. However, upon wetting, the cementing softens and the loose structure often collapses, particularly when the soil is stressed by foundation loads. The result can be excessive settlement or bearing capacity failure. The potential for settlement has been related to natural dry density and moisture content in terms of the Proctor density and moisture in Figure 18.

Careful attention to grading and drainage can do much to prevent settlement or shear failure of loess soils. Stripping the natural vegetation

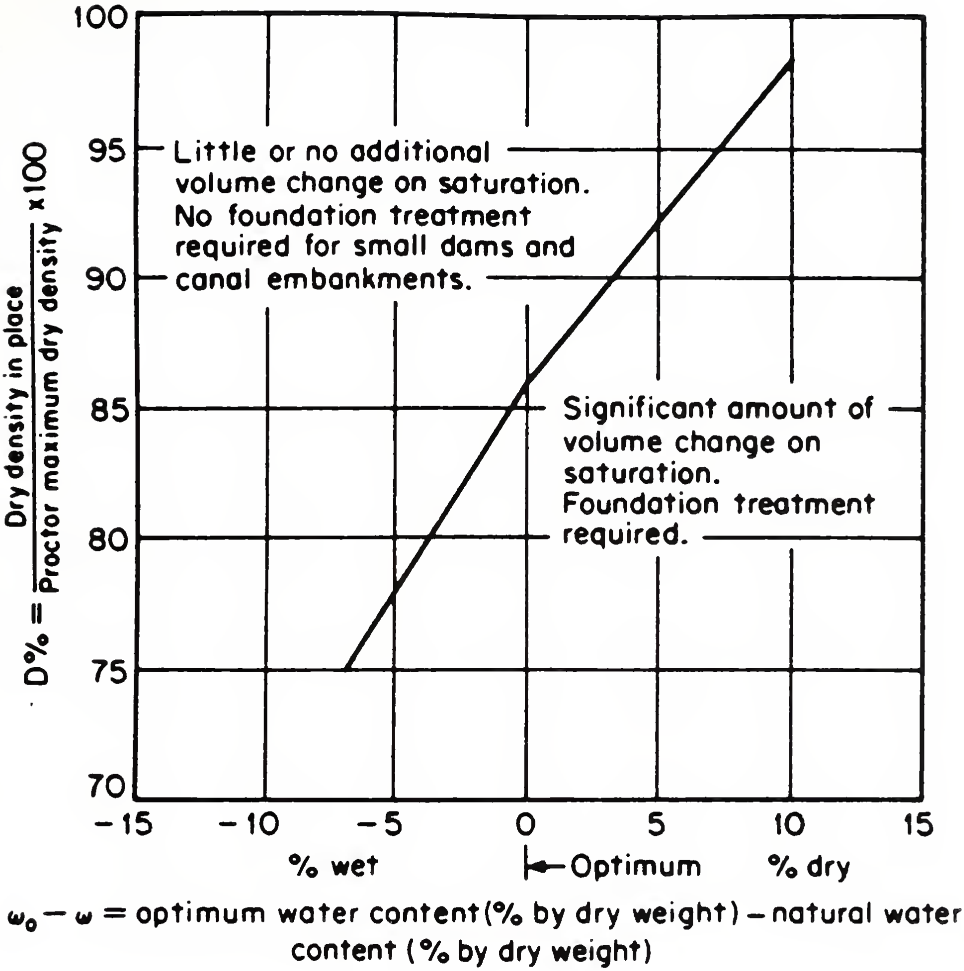


FIGURE 18. POTENTIAL FOR LOESS SETTLEMENT (30).

leaves loess vulnerable to rainfall saturation and possible ground collapse. Site grading and drainage require planning to avoid the ponding of water, and utilities must be constructed so as to prevent leaks (28).

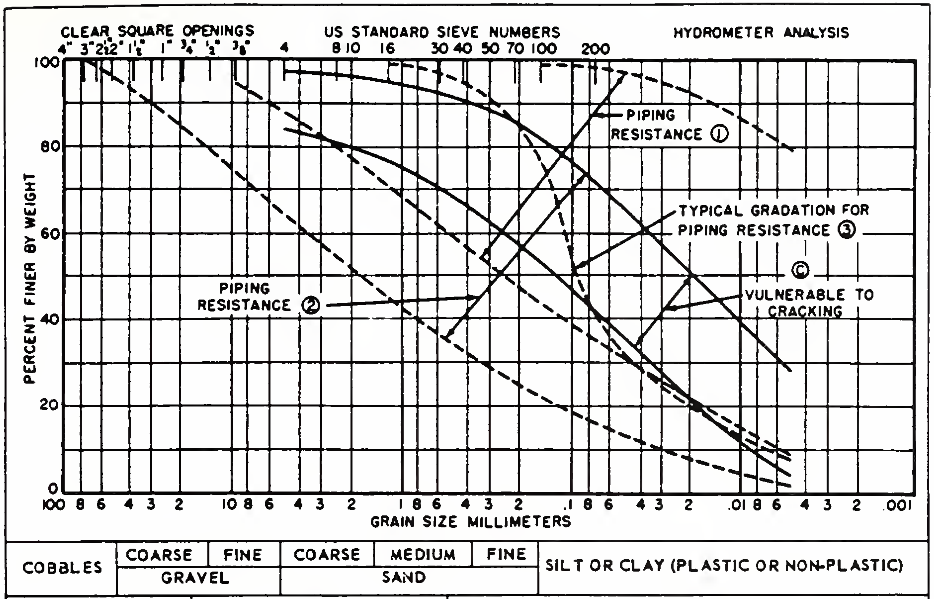
Prewetting these areas has been employed in some cases, but this could result in so soft a condition that the site is no longer usable. Precompaction of the loess by ramming the soil in narrow columns has also been used. Additional stability can be obtained using lime, lime fly ash, or a cement as a stabilizing agent (27).

Embankment construction can be difficult in loess areas. When loess is dry, compaction is virtually impossible as the silty soil tend to blow away. Also, if placed in an embankment in an excessively wet condition, loess can become quick, suddenly losing strength and flowing. However, at proper moisture contents, slightly below optimum for maximum density (35), loess makes suitable compacted embankment fill; but it must be protected against piping erosion and possible cracking due to foundation settlement, especially for earth dam embankments. Figure 19 gives ratings for Unified classified materials according to their resistance to piping and cracking.

Loess can be subject to large capillarity. This results in heaving of foundations and pavements upon freezing (frost heave).

Loess naturally stands on a vertical slope, therefore cut slopes are usually more stable when made vertical. Cut slopes other than vertical should be stabilized by vegetation, and a drainage ditch should be placed along the top of the slope to prevent wetting (35).

Dune sands are generally noncohesive and loose. The porosity and per-



Category	Material	Characteristics
Piping resistance:		
①	CL and CH with PI > 15, well graded SC with PI > 15.	Greatest resistance to piping, small and medium concentrated leaks will heal themselves. Embankment may fail as a result of slowly progressive piping caused by leak of about 1/2 cfs.
②	CL and ML with PI < 15, well graded SC and GC with 15 > PI > 7.	Intermediate resistance to piping. Safely resists saturation of lower portion of downstream slope indefinitely. May fail eventually as a result of erosion caused by a small concentrated leak or by progressive sloughing. If a large leak develops, piping causes failure in a short time.
③	SP and uniform SM and ML with PI < 7.	Least resistance to piping. Usually fails in a few years after first reservoir filling if seepage is able to break out on downstream slope. Small concentrated leak on downstream slope can cause failure in a short period of time. High density from compaction increases resistance significantly.
Cracking resistance:		
Ⓐ	CH with $D_{50} < 0.02$mm and PI > 20.	High postconstruction settlement, particularly if compacted dry. Has sufficient deformability to undergo large shear strains from differential settlement without cracking.
Ⓑ	GC, SC, SM, SP with $D_{50} > 0.15$mm.	Small postconstruction settlement. Little chance for cracking unless poorly compacted and large settlement is imposed on embankment by consolidation of the foundation.
Ⓒ	CL, ML and SM with PI < 20, 0.15 mm > D_{50} > 0.02 mm.	Medium to high postconstruction settlement and vulnerable to cracking. Should be compacted as wet as possible consistent with strength requirements.

FIGURE 19. RESISTANCE OF EARTH DAM EMBANKMENT MATERIALS TO PIPING AND CRACKING (29).

meability are moderate to high, and the water table is seasonably high in low lying areas. Dune sand is usually classified as SM, SP, or SP-SM material.

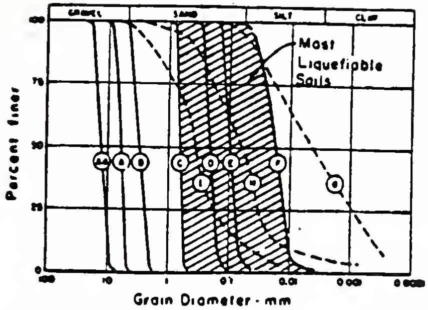
Dune sand is a good to excellent foundation and subgrade material. However, it may be difficult to compact because of its uniform gradation. It is poor practice to place foundations on sand deposits where the relative density is not at least 60 percent or to a density of about 90 percent or more of the maximum density possible (27). This dense state reduces the possibility of both load settlements and possible settlement damage due to equipment or earthquake vibrations.

The sand dunes in Knox County are permeable and yield some water. However, the water table fluccuates so that water supply is small and undependable. The deposits serve as infiltration areas for underlying outwash aquifers. Sanitary landfills should be avoided in these areas as drainage through these materials is rapid, and effluent is likely to contaminate groundwater in underlying or adjacent aquifers.

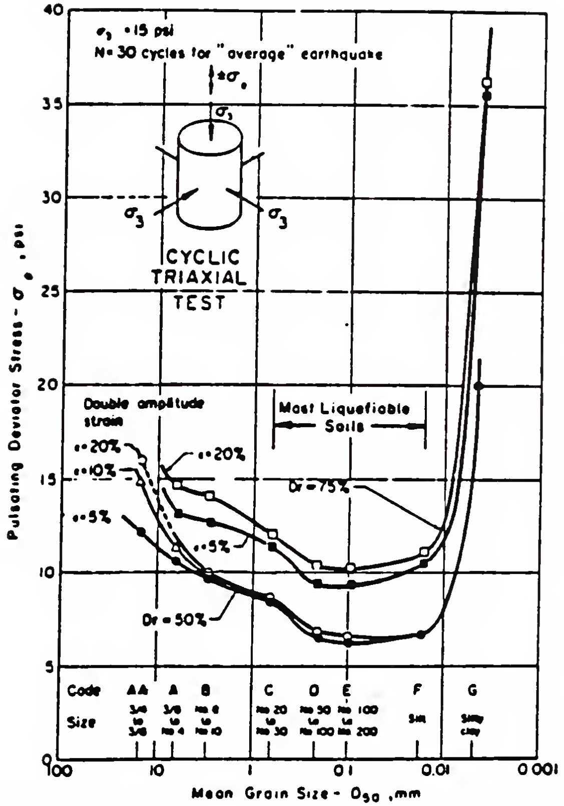
Loess and fine dune sand can be very susceptible to liquefaction when saturated and stresses dynamically. This is an important consideration as Knox County has historically been one of the most active seismic areas in the state (36). Figure 20 shows grain size distributions for the most liquefiable soils and the effect of this gradation on the cyclic strength of the materials.

LACUSTRINE DRIFT

Lacustrine drift is the second largest parent material region found in



a. GRAIN-SIZE DISTRIBUTIONS



b. EFFECT OF GRADATION ON CYCLIC STRENGTH

(From Lee and Fitton, 1968)

FIGURE 20. GRAIN-SIZE AND STRENGTH CHARACTERISTICS OF THE MOST LIQUEFIABLE SOILS (36).

Knox County. These lacustrine and slackwater deposits are mainly of Wisconsinan age. Lacustrine landforms are predominantly flat and exhibit a very dark photo tone. However, frequently low dunes and silt mounds are superimposed upon their surfaces.

Lacustrine Plain

The areas classified as lacustrine plain are found adjacent to the White River in the eastern portion of the county. These four lake plains exhibit a flat topography, very dark photo tone, and no surface drainage. Although, man-made ditch systems are developed in some areas. These plains are bordered by low, light toned ridges in some locations, however, in most areas these beach ridges are not discernible. Shoreline features are probably covered with loess or recent alluvial deposition.

The surface soils consist mainly of silty clay (A-7), silty clay loam (A-6, A-7), or silt loam (A-4, A-6). Silty clay and silty clay loam extend beneath the surface soil to a depth of 60 to 70 inches. The underlying soils are mainly stratified silty clay and clay. However, these lacustrine deposits may be erratic at depth, with organic pockets, sand lenses, and gravel seams possible. Also, they may interfinger with outwash and alluvium at their margins.

The agricultural soils that form in these areas are usually the Kings, Patton, and Zipp series.

Slackwater Plain

Most slackwater plains in Knox County are confined to tributary valleys of the Wabash and White Rivers. These rivers carried large volumes of meltwater from the waning Wisconsinan ice sheets, which eventually choked their valleys with sand and gravel, damming and ponding their tributary streams. More recent slackwater deposition has taken place within the Wabash Valley, where deposits of lacustrine drift have accumulated in flood plain fluves cut into outwash terrace surfaces.

These plains are nearly level, and therefore the deposits are thin in upstream branches and thicker downvalley. Natural drainage is usually absent on these poorly drained flats, and extensive ditch systems are developed. Most slackwater plains in the county are cleared of trees and farmed.

The surface soils, to a depth of 12 to 24 inches, usually consist of silty clay (A-7), silty clay loam (A-6, A-7), or loam (A-4, A-6). Some sand occurs in areas where small valleys enter the slackwater plain. The subsoil varies from silty clay, silty clay loam, sandy clay loam (A-6), clay loam (A-6), to loam. The underlying material is stratified silty clay loam, silty clay, and clay (A-7) in the tributary valleys. The more recent deposits are underlain by outwash deposits of gravelly sand loam (A-2) or stratified sands and gravels (A-1). Near the borders of the tributary deposits, interfingering with outwash and alluvial materials is common. Also, organic deposits may be buried at depth.

Shoreline features are not developed along the margins of these deposits. Absence of these beach features may be caused by a lack of proper materials or by a failure of the slackwater lakes to maintain their positions long enough for the formation of shoreline ridges.

The agricultural soils that form in these areas are the Kings, Markland, McGary, Patton, Selma, and Zipp series.

Boring numbers 22-46, 85-87, 104-106, and 108 are located in the slackwater plain region. These borings are mainly along US 41 in recent slackwater deposits overlying outwash material.

Slackwater Terraces

Slackwater terraces in Knox County are found mainly along the valleys of Maria and Indian Creek. These tributaries of the Wabash and White Rivers respectively, have regained their valleys by eroding the lacustrine drift that once filled them. The erosion has left slackwater surfaces 10 to 15 feet above the present flood plains. These landforms exhibit much of the same characteristics of the slackwater plains.

These poorly drained flats are very level and exhibit a dark photo tone. Drainage is usually absent; however, some shallow gullies may be present.

The surface soils, to a depth of 12 to 24 inches, consist mainly of clay loam (A-6), silt loam (A-4, A-6), silty clay loam (A-6, A-7), or silty clay (A-7). The subsoil, to a depth of 54 to 84 inches, can contain some sand as alluvial materials often mix somewhat with these deposits. These soils are usually silt loam, silty clay loam, silty clay, or sandy loam (A-6). The underlying material is usually stratified silty clay loam, silt loam, and clay.

The agricultural soils that form in these areas are the Kings, Markland, McGary, and Patton series.

Oxbow

These deposits of lacustrine drift are confined to abandoned river meanders of the Wabash and White Rivers. These deposits exhibit a very dark photo tone and are usually "half-moon" or "snake" shaped. Oxbows are very poorly drained and show no surface drainage features.

The surface soil is generally clay loam (A-6), silty clay loam (A-6, A-7), or silty clay (A-7). These soils usually have a high organic content. The subsoil is either clay loam, silt loam (A-4, A-6), silty clay loam, or peat (A-8). The fibrous peat can be up to four feet thick in places. The underlying material is usually clay (A-7), sandy clay (A-6), or silty clay.

The agricultural soils that form in these areas are the Kings, Wallkill, and Zipp series.

Engineering Considerations in Lacustrine Drift

The lacustrine deposits in Knox County are principally classified as ML, CL, MH, or CH material, otherwise described as lean to fat clay and silt. These deposits are moderately to highly plastic, with plasticity indices ranging from 20 to 41 and liquid limits varying from 35 to 60 (2).

These materials are very porous, but relatively impermeable. The water table is high as the result of strong capillarity. Also, the surface is subject to flooding; however, many of these areas are protected by man-made levees.

The drainage of these soils is naturally very poor, and in a wet condition the plastic nature of the material makes it unsatisfactory for pavement subgrades because the high potential for shrink-swell. Also, the capillarity in these fine-grain deposits make them subject to heave upon freezing. Roads constructed in these areas should use a suitable compacted fill that will insulate the pavement from the lake deposits (19).

Compaction is difficult in these materials. Close control of the moisture content must be maintained. The compacted fill is susceptible to pumping, frost heave, and sideslope problems. The compacted soil has a low permeability; however, it is not recommended for use in dikes, embankments, or drainage canals, because of its low erosion resistance. The material also should not be used for water retention structures where seepage is critical.

Cut slopes in these lacustrine deposits should be made with special attention as natural slopes in these material are not reliable guides to permissible cut slope designs. Very poor drainage, together with a typically high water table and high water content (Figure 21), makes it impossible for the zone of saturation to adjust quickly to the new cut surface, so that slumping in deep cuts is nearly inevitable. If the hazard is recognized in advance, remedial measures can be taken. The simplest is to plan for a lower slope angle, which not only reduces forces at the toe of

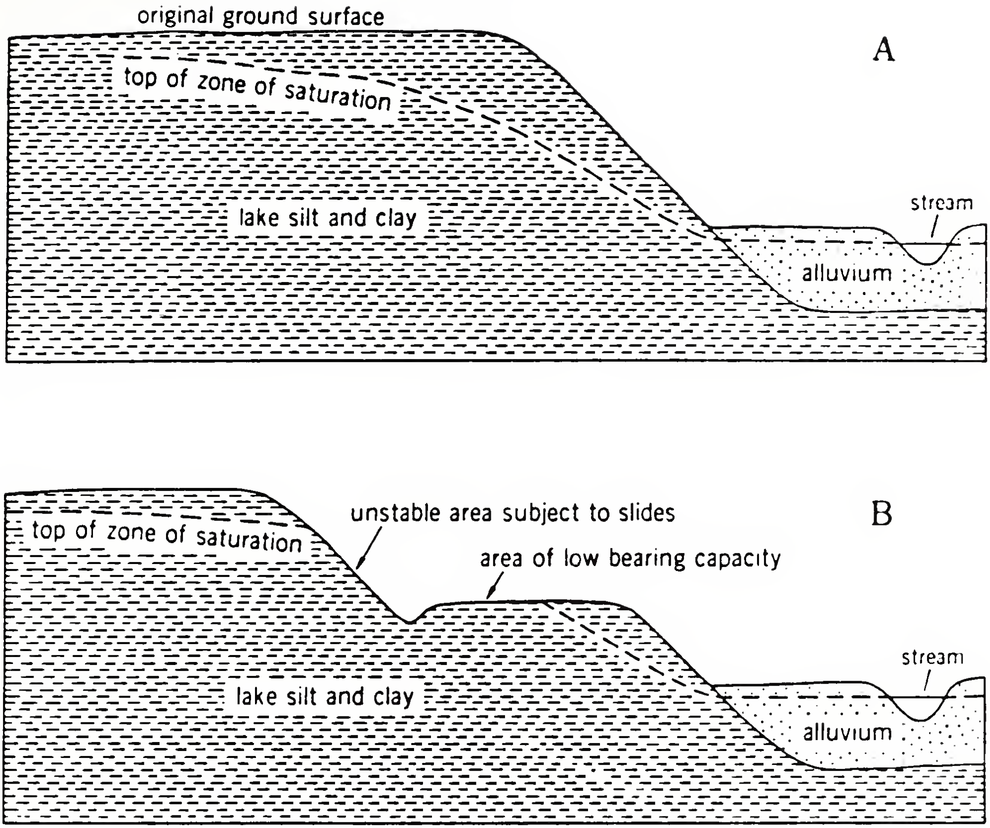

original ground surface
A
top of zone of saturation
lake silt and clay
stream
alluvium
unstable area subject to slides
B
top of zone of saturation
area of low bearing capacity
lake silt and clay
stream
alluvium

FIGURE 21. A, Cross section showing natural slope on lake silt and clay, and B, Same cross section showing new cut that exposes saturated, unstable material. In A, top of zone of saturation has become adjusted to this slope over a long period of time. Most rainfall runs off and top of zone of saturation fluctuates little. In B, internal drainage of lake silt and clay is so slow that slumping is likely before top of zone of saturation can achieve equilibrium with new ground surface (19).

the slope, but also opens more area to capillary drying. Developing cuts in stages over a period of several months, to allow time for the water table to adjust, may also be used to minimize slumping of cut slopes in these regions (19).

Lacustrine deposits in Knox County are normally consolidated; this means that the deposits have not been "preconsolidated" or stressed by loads greater than those exerted by the weight of the material itself. Placing a load of any kind, such as a building, dam, or highway fill, on these materials could result in consolidation of the deposit, accompanied by settlement of the structure. The amount of settlement is a function of added load, thickness of underlying lacustrine drift, water content, and clay content of the deposits, and time. Large differential settlement can be expected where loads are very unevenly distributed or where structures are founded partly on stable bedrock and partly on thick lacustrine material (19).

One solution to the settlement problem in these lacustrine soils is the use of a partially compensated foundation, where the soil is excavated to a depth such that the effective weight of the removed soil is nearly equal to the weight of the structure. Partial compensation is easily accomplished by the construction of a basement; however, the high water table in these areas may make this difficult. An appropriate design approach for large, heavy structures may be to distribute the load widely with a slab or mat foundation. This method reduces contact pressures, therefore reducing settlements.

Water supply is a problem in many of these regions. Although these deposits contain a great amount of water, they are of such low permeability that water in them cannot be removed by pumping. Scattered lenses of saturated sand and gravel in and at the base of these deposits tend to be "quick" as a result of their high silt and clay content. These materials clog well screens and pumps, and at best the yield from these lenses is low (19).

The high water table, flood hazard, and nearly impermeable nature of these materials makes the use of septic tanks and associated tile fields impracticable. Where lacustrine drift is thick and protected from flooding, sanitary landfills may be feasible. Because water moves extremely slow through these deposits, contamination of nearby water bodies is unlikely, and the high water table is a problem mainly in its effect on access and excavation (31).

Oxbow deposits are unsuitable for most engineering considerations and should be avoided. They are subject to frequent flooding, possess a high water table, and are extremely compressible.

FLUVIAL DRIFT

The areas of fluvial drift parent material in Knox County include flood plains and river terraces. The flood plains of the Wabash and White Rivers differ in composition and morphology from those of their tributaries, and therefore are separated for discussion.

Wabash and White River Flood Plains

The wide flood plains of the Wabash and White Rivers are characterized by nearly level topography and variable photo tones. The depth of these deposits is quite variable and they generally overly glacial outwash or bedrock. The channels themselves are usually incised in outwash; however, bedrock is exposed at some places in the floor of these channels (17). Also, anastomatic drainage patterns are found in both valleys.

The surface soils of these flood plains consists mainly of silt loam (A-4, A-6), silty clay loam (A-6, A-7), or sandy loam (A-4, A-6, A-2). The underlying soil is silt loam, silty clay loam, sandy loam, or loam (A-4, A-6). However, extreme variation may occur with distance and depth. In general, coarse material is not plentiful, but, at depth, sand and gravel lenses may be present. Also, some surface soils are highly organic, and organic pockets may be found at depth.

The agricultural soils that form in these areas are the Haymond, Nolin, and Petrolia series.

Minor landforms present in these flood plains include natural levees and abandoned river courses in the form of meander scrolls, oxbows, and oxbow lakes. Natural levees are curvilinear ridges and swales, a few feet in magnitude, composed of overwash sand and gravel. Sand dunes are also scattered throughout the Wabash Flood Plain, and point bars and sand bars are found in and along the present channels of both the Wabash and White Rivers.

Boring numbers 1, 92-103, and 109-112 are located in this region.

Tributary Flood Plains

The tributaries of the Wabash and White Rivers are generally underfit for their flood plains, and have low gradients except in their upvalley branches. These flood plains are absent of mature flood plain features such as abandoned river courses, natural levees, and point bars. The poorly drained character of most of the tributary flood plains gives them a relatively dark photo tone.

The soils that compose these flood plains are mainly silt loam (A-4, A-6), with most of this material having been washed in from the surrounding loess covered uplands, and loam (A-4, A-6). The underlying soil may contain more sand and is classified as silt loam, loam, sandy loam (A-4, A-6, A-2), or fine sand (A-3). Variations may occur both vertically and laterally in these deposits. Granular lenses and organic pockets should be anticipated. Also, these materials may interfinger with adjacent slackwater deposits.

These alluvial soils are underlain by a variety of materials. In their upper courses, they generally are found mantling loess; however, downvalley they are usually found over Illinoian drift and sandstone-shale bedrock. Tributary flood plain deposits may also cover outwash. This occurs primarily along Maria Creek, as well as the outlet areas of many other tributary valleys.

The agricultural soils that form in the tributary flood plains are primarily the Birds, Hickory, Sylvan, and Wakeland series.

Boring numbers 3, 19, 20, 90, and 91 are located in this region.

River Terrace

River terraces in Knox County are located along the Wabash River, White River, and Maria Creek. The terrace surfaces are gently undulating to nearly level, and rarely exceed a few feet in relief. The river terraces in Knox County are former flood plains and often exhibit curvilinear boundaries. Surface drainage is absent; however, current scars are present in some areas.

The surface soils consist mainly of loam (A-4, A-6) or silt loam (A-4, A-6) to a depth of 8 to 18 inches. The subsoil, to a depth of 48 to 72 inches, is generally composed of loam, clay loam (A-6), sandy clay loam (A-6), silt loam, silty clay loam (A-6, A-7), sandy loam (A-4, A-6), or fine sand (A-3). The underlying material is usually stratified loam and sandy loam to stratified sandy loam and clay loam. However, the texture of these deposits varies greatly from one location to another. Overwash sand and gravel and slackwater material is found on some surfaces. Also, lenses and pockets of granular materials, silts and clays, and organics can occur at depth.

The agricultural soils that form in river terrace areas consist mainly of the Armiesburg and Proctor series.

Engineering Considerations in Fluvial Drift

The fluvial deposits in Knox County, both the flood plains and low terraces, are classified predominantly as CL, CL-ML, ML, SC, or SM-SC materials. These deposits are slightly to moderately plastic, with plasticity indices ranging from 5 to 25. Liquid limits generally vary between 30 and 45 (2).

The groundwater table is seasonably high in these areas and flooding is common; however, some areas are protected by levees and rarely flood. The hydraulic properties of these materials is generally poor. Permeability varies considerably from one location to another. These predominantly fine materials are also subject to high capillarity, high frost-heaving, and high liquefaction susceptibility (28). These conditions result in poor subgrade support for pavements. Therefore, roads should be constructed on raised, well-compacted granular fill material with adequate side ditches and culverts to reduce flood and frost damage (2). A geotextile might also be used to separate the poor subgrade and the granular base. This would eliminate mixing of the materials, which causes a reduction in the strength of the granular fill, and would reduce the amount of aggregate needed (39).

Foundation and excavation problems are associated with the generally saturated and non-uniform strength of these deposits. The soils have a moderate to high bearing capacity. However, differential settlements can occur when subsurface variations such as compressible organic pockets or loose sand lenses are present in the subsoil. The locations of such variations require a detailed site investigation. Scour of these soils should also be anticipated in any bridge foundation design. Excavations in these materials may be difficult to maintain during high water periods, and are often subject to sidewall caving (28).

Embankment construction can be difficult in these areas. Compactibility is a problem and requires careful moisture control. These fine fluvial sediments are also subject to piping and postconstruction settlements and associated cracking (see Figure 19).

Septic tanks and sanitary landfills are impracticable in these regions because of potential flooding and rapid effluent flow (2).

GLACIAL-FLUVIAL DRIFT

Glacial-fluvial drift takes the form of outwash terraces in Knox County. These materials were deposited by large volumes of melt water from Wisconsinan age glaciers, and were reworked by overflow waters of Glacial Lake Maumee and more recent erosion. In Knox County, these materials are predominantly medium and fine sand with a lessor amount of gravel.

Outwash Terrace

Outwash terraces in Knox County are located primarily along the Wabash and White Rivers. These landforms are often dissected by recent slackwater fluves. Smaller, more isolated, terraces are found along Maria and Indian Creek.

The terrace surfaces generally have a level to gently undulating topography and exhibit an overall uniform light gray photo tone with dark specks. The specks are infiltration basins, which are common features in coarse-textured deposits with internal drainage. Though surface drainage is usually absent, old current markings are visible on numerous surfaces. The terraces are often modified by low dunes and gravel pits. Also, because the outwash deposits are very sandy, they are subject to wind erosion which causes blowouts in some areas.

The texture of outwash deposits in Knox County varies greatly from place to place. The surface soils generally consist of loam (A-4, A-6) or sandy loam (A-4, A-6) and are highly organic in some locations. The upper portion of the subsoil is sandy clay loam (A-6), clay loam (A-6), gravelly sandy clay loam (A-4), gravelly sandy loam (A-2), or sandy loam. The lower part of the subsoil to a depth of about 65 inches, is sandy clay loam, stratified sandy loam, sandy clay (A-4), gravelly loamy sand, or sand (A-3). The underlying material is usually stratified sand and gravel (A-1), sand, loamy sand, or stratified loamy sand. Sandstone-shale bedrock is found in some areas as close as five feet from the surface.

The agricultural soils that form in these areas are the Chetwynd, Conotton, Elston, Selma, and Stockland series.

Boring numbers 47-79, 81-83, and 107 are located in outwash terraces.

Engineering Considerations in Glacial-Fluvial Drift

Outwash materials are usually nonplastic; however, surface soils may be slightly plastic (PI 4-12). The porosity and permeability are generally high. These deposits are quite variable and classified as GP to SM material.

The water table is high in low lying areas and such areas are subject to flooding. In these locations excavations and cut slopes need to be properly drained to prevent collapse.

Outwash surfaces are essentially nonsusceptible to frost heave, liquefaction, or piping. However, the potential increases where surface material fineness increases.

Bearing capacity is good to excellent and settlements are generally immediate and low in magnitude. However, susceptibility to densification by vibration can be high.

Outwash deposits are an important source of sand and gravel in Knox County. They are also important aquifers, as discussed previously.

The high permeability of these deposits makes septic tanks and sanitary landfills impracticable as drainage is rapid and leachate is likely to contaminate groundwater.

CUMULOSE DRIFT

Cumulose drift occupies a few scattered areas in Knox County. For discussion purposes these organic deposits are divided into two categories: muck and marl deposits, and swamp deposits.

Muck and Marl Deposits

The areas classified as muck and marl deposits are located in flood fluve depressions on outwash terraces just south of Vincennes. These deposits exhibit flat topography, a very dark photo tone, and no surface drainage.

In a typical profile the surface layer, to a depth of about 13 inches, is black muck (A-8) containing approximately 10 percent fibers. The subsoil, to a depth of 28 to 50 inches, is friable marl (A-8) that is 5 to 10 percent gravel. The underlying material is generally gravelly sand (A-3, A-1).

The agricultural soil that forms in these areas is the Edwards Variant series.

Swamp Deposits

The largest area of cumulose drift is Cypress Swamp, located in the extreme southwestern part of Knox County. Cypress Swamp exhibits a flat topography, a very dark photo tone, and heavy tree growth.

The surface soils consist of a black silty muck (A-8) to a depth of 30 inches. The substratum, to a depth of about 60 inches, is brown fibrous peat (A-8) containing partly decomposed leaves and small tree branches. The underlying material includes clay (A-7), silty clay (A-7), clay loam (A-6), silty clay loam (A-6, A-7), and gravelly sand (A-3, A-1).

The agricultural soils that form in these areas are the Edwards Variant and Wallkill series.

Engineering Considerations in Cumulose Drift

Cumulose drift is characterized by very high organic contents, low densities, very high natural water contents, a loss in mass on ignition, and substantial shrinkage upon drying. Peat and muck in their natural state generally have a very high permeability; however, as the material is compressed, the permeability is greatly reduced (37).

Two characteristics associated with peats and mucks make them undesirable as foundation materials for buildings and embankments. First, these materials compress excessively when subjected to an applied load. A large portion of this compression is a result of relatively high amounts of secondary compression. These deformations occur over a long period of time, which compounds the problem. Also, these deposits possess low preconsolidation pressures, therefore a large compression response is likely even at low stress levels. Secondly, peats and mucks are characterized by very low shear strengths and consequently very low bearing capacities (37).

These materials should be avoided in construction; however, if this is not possible, shallow deposits should be removed and repaced by a more desirable material. If the deposits of peat and muck must be used as a foundation material, the mechanical properties can be greatly improved by preloading the material with a surcharge. Preloading would improve the engineering properties in two ways. First, the expected settlements would be accelerated such that when the surcharge is removed the settlements under the design load would be drastically reduced; and secondly, consolidating the peat and muck would greatly increase their shear strength (37).

These cumulose deposits are usually highly acidic, and therefore are very corrosive to steel and concrete.

MINED LAND

Knox County contains many areas which have been modified by mining activities. Coal-strip mines are found throughout the northeast part of the county, and numerous gravel pits are located in the Wabash Valley.

Coal-Strip Mines

Coal-strip mines are a prominant landform in the northeast part of Knox County. The largest portion of these areas consist of narrow, elongated mounds of spoil. This spoil material is a mixture of shale soil, glacial till, and sandstone fragments. Also included in the mapping unit are uneven piles of carbonaceous shale, low grade coal, and waste rock. In some areas, the mine spoil was shaped and smoothed after mining. However, usually only the peaks were smoothed, leaving elongated pits that mostly contain water. The sides of many pits are steep, and large sandstone fragments are exposed at the surface. The sites also contain abandoned mine haul roads that consist mainly of extremely acidic carbonaceous shale and other mining refuse (2).

Surface runoff in these regions is very rapid and gully development is great.

In a typical soil profile the surface soil, to a depth of 18 inches, is generally shaley silt loam (A-4, A-6, A-2) containing 30 percent shale and 10 percent sandstone fragments. The subsoil, to a depth of 60 inches, is shaley silty clay loam (A-7, A-2) or gravelly clay loam (A-4, A-6) consisting of 35 percent shale, 15 percent sandstone, and two percent coal fragments. Bedrock is usually found at a depth greater than five feet (2).

The agricultural soil that predominantly forms in these areas is the Fairpoint series.

The Springfield coal is the most widely mined coal seam in Knox County. It is a high-volatile C bituminous coal with an average thickness of five feet. The coal contains numerous thin bands of pyrite and marcasite. Also, large pyrite concretions are abundant in the top one foot of the coal and overlying shale (17). It has a moderate amount of ash, but has a high sulfur content; therefore 80 percent of the mined coal is mechanically cleaned (32).

Gravel Pits

Gravel pits in Knox County are found on outwash terrace surfaces throughout the Wabash Valley, with the majority located just south of Vincennes. These areas are generally rectangular and range from 5 to 60 acres (2). Most sites contain water-filled pits.

The materials consist mainly of sand and gravel separated out during gravel mining operations. This material is either found in mounds or has been graded.

A study of gravel samples in a pit near Vincennes (Robinson Pit, center of section 23) showed the composition of these outwash gravels to be predominantly sedimentary (34). The rock types found were chert (39% by weight), dolomite (14%), limestone (9%), dolomitic limestone (5%), sandstone (6%), granite (3%), rhyolite (9%), quartzite (4%), and other (11%).

The high chert (silica) content makes this aggregate susceptible to alkali-silica reaction when mixed with high-alkali cement. This reaction results in a silica gel which swells upon wetting, causing expansion cracks in concrete pavements.

Engineering Considerations in Mined Land

The materials in coal-strip mine areas are quite variable and in some places unknown. This worked-over spoil is generally slightly to moderately plastic (PI 4-24) and has a relatively low permeability (2).

Foundations and roads should be designed to compensate for large differential settlements, which can be expected in this variably compacted and fragmented material. The surface soils also have a high potential for piping and shrinking and swelling. The material can also be very corrosive to steel and concrete.

Most of these areas are best suited for wildlife and recreation (2).

Sanitary landfills are possible in old stripped areas and active pits. If the predominant rock-type underlying the site is shale and no major aquifers exist beneath the site, refuse could be placed in existing trenches and final surfaces raised to enhance surface runoff. Also, the presence of a continuous layer of underclay could provide an additional barrier to downward movement of any leachate. And in many cases, effluent from the spoil banks is already contaminated with iron and sulfate leached from minerals in the soil. However, extreme care must be taken in planning such landfills (31). Gravel pits should be avoided in planning sanitary landfills because of their high permeability and potential for polluting shallow water supplies.

Surface mining and reclamation have affected surface-water quality in much of southwestern Indiana, especially in the coal-mining areas. Because of the oxidation and the weathering of pyrite and marcasite exposed in mining operations, drainage in many old mining areas has an acidic pH (<7). In Indiana, many of these areas were mined before passage of the Indiana Reclamation Law of 1968 (Indiana Code 13-46), which mandates that spoil piles be graded and cover vegetation be established. Although acid mine drainage has been reduced by current mining operations as a result of the preferential burial of pyrite, acidic drainage from old mining operations continues to be a water-quality problem (5).

Acid mine drainage is not the only water quality problem. Concentrations of many dissolved and suspended constituents, including iron and aluminum, are higher in both old and new mining areas than in natural water. Also, erosion from unreclaimed areas of old mines or unvegetated areas of new mines can substantially increase sediment loads in surrounding streams (5).

Underground mines and potential subsidence are also a source of concern in Knox County. Figure 22 shows numerous underground coal mines in the east-central portion of the county.

Subsidence is indicated by the formation of sinkholes, ponds and troughs, alteration of the flow of groundwater, and damage to man-made structures. However, the problem of recognizing certain types of damage from mine subsidence is difficult because of its similarity to damage

2 spaces

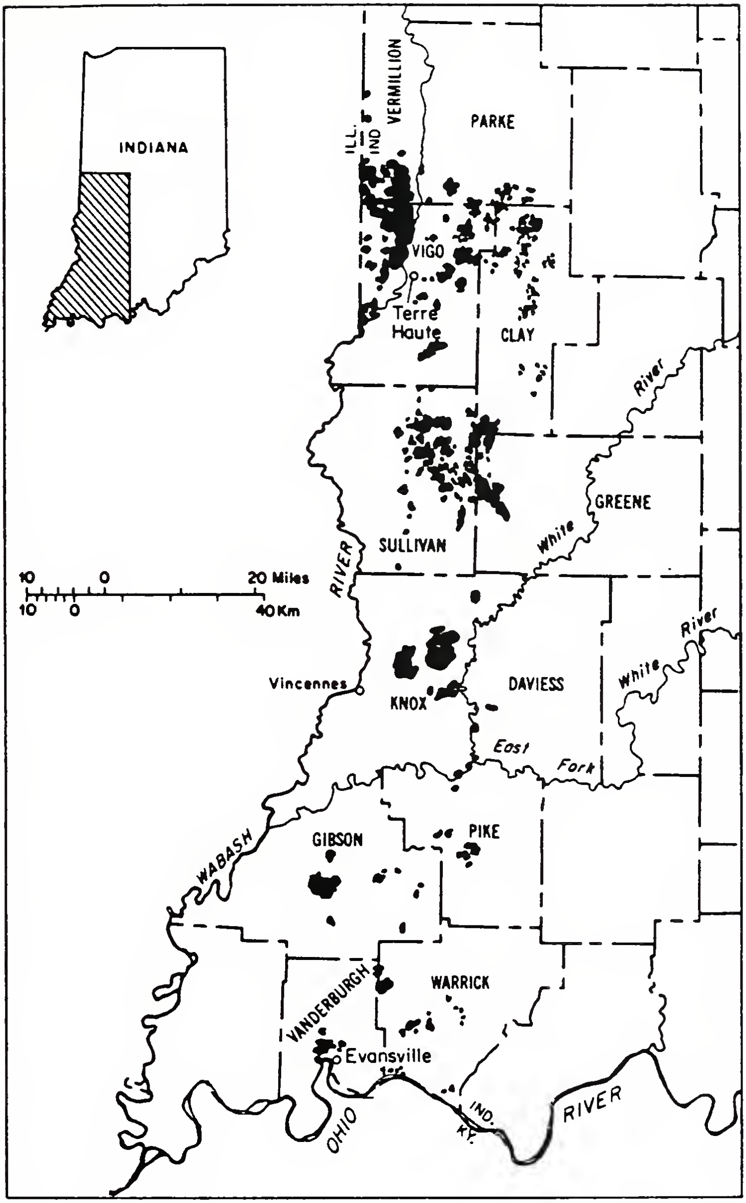


FIGURE 22. MAJOR UNDERGROUND COAL MINES IN SOUTHWESTERN INDIANA (33).

created by other causes. In many areas, damage from poor construction, freeze-thaw cycles, differential settlement, and subsidence due to withdrawal of groundwater cannot be differentiated from damage due to mine subsidence (33).

If large structures are being planned and doubt exists concerning the extent of undermining, a drilling progam is necessary to determine if a mine is present. The proper spacing of drill holes is critical for proper evaluation. Drilling must take into account possible unmined pillars of coal (33).

If a prospective building site is known to be undermined, backfilling the mined-out space or using special foundation construction techniques should be employed to minimize any damage arising from future subsidence.

SUMMARY OF ENGINEERING CONSIDERATIONS IN KNOX COUNTY

A summary of engineering considerations for each landform-parent material region in Knox County is given in Table 7. This rating system is particularly useful for soil engineers inexperienced with geotechnical characteristics of the soils in the county. This approach is based upon work by Sisiliano and Lovell (38) on the use of regional or physiographic subdivisions in the preliminary stages of planning and investigation. Each landform has been given a general rating (L, M, H or 1, 2, 3) for a specific highway or construction problem. Landforms that exhibit considerable variation in engineering properties have been rated over a given range. Small areas which show extreme variation in texture and engineering

TABLE 7. SUMMARY OF ENGINEERING CONSIDERATIONS FOR LANDFORM-PARENT MATERIAL REGIONS IN KNOX COUNTY.

EXPLANATION		CUT DESIGN					EMBANKMENT FILLS					EMBANKMENT FOUNDATION				SUBGRADE				FOUNDATION DESIGN								MISCELLANEOUS				
PROBABILITY OF A MAJOR PROBLEM DEVELOPING L (LOW) M (MEDIUM) H (HIGH) AVAILABILITY RATING 1 (LOW) 2 (MEDIUM) 3 (HIGH)							COMPACTED PROPERTIES													SHALLOW FOOTINGS			PILES									
LANDFORM	GENERAL SOIL TEXTURE	SOIL/ROCK BACKSLOPE INSTABILITY	GROUND WATER CONTROL	EROSION POTENTIAL	SURFACE DRAINAGE	NATURAL SLOPE AND RIVER BANK INSTABILITY	EROSION RESISTANCE	RELATIVE PERMEABILITY	INADEQUATE SHEAR STRENGTH	COMPRESSIBILITY WHEN SATURATED	WORKABILITY PROBLEMS	INADEQUATE SHEAR STRENGTH	EXCESSIVE SETTLEMENTS	ORGANIC DEPOSIT OCCURENCE	GROUNDWATER CONTROL	SUBGRADE SUPPORT INADEQUATE	FROST ACTION POTENTIAL	PUMPING POTENTIAL	SHRINK-SWELL POTENTIAL	INADEQUATE BEARING CAPACITY	EXCESSIVE SETTLEMENT POTENTIAL	SCOUR POTENTIAL	INADEQUATE BEARING CAPACITY	EXCESSIVE SETTLEMENT POTENTIAL	NEGATIVE SKIN FRICTION	SCOUR POTENTIAL	ESTIMATION OF LATERAL EARTH PRESSURES FOR RETAINING STRUCTURES	AVAILABILITY OF AGGREGATE	STEEL CORROSIVITY	CONCRETE CORROSIVITY	BEHAVIOR OF SEPTIC TANK FIELDS	GROUNDWATER RESOURCE POTENTIAL
LOESS PLAIN	SILT	H	H	M	M	H	H	2	M	M	M	M	M	L	L	M	M/H	H	H	M	M	M	L	L	M	M	M	1	M	M	M	1
LOESS ON SLACKWATER PLAIN	SILT, CLAY	M/H	M	M	M	M/H	M/H	1-2	M/H	M/H	H	M/H	M	M	L	L/M	M/H	M/H	M/H	M	H	M	M	M	H/M	M	M	1	M	M/H	M	1
LOESS ON SANDSTONE SHALE BEDROCK	SILT, CLAY, SAND	M/H	L/M	M	L/M	M	M/L	2-3	M/H	M	M/H	H	M/L	L	M	M	H	H	M	M	L/M	M	M	M/H	M	M/L	M	1	M	M	M	1
SAND DUNES	SAND	M	M/H	M	M	M	M	1-3	M	M	M	M	M	L/M	M/L	M	L/M	M	L/M	M	M	M	M/H	M	L/M	M/L	M	2	M	M	H	1
SAND WITH INCIPIENT DUNE DEVELOPMENT	SAND, SILT, GRAVEL	L	M	H/M	L	L	H/M	3	L	L	L	L	L	L/M	M	L	L/M	L	L	L	L	H	L	L	L	H/M	L	2-3	L/M	L/M	H	3
SAND ON SANDSTONE-SHALE BEDROCK	SAND,SILT,ROCK	M	M	H/M	M	M	M	3	L	L	L/M	M/L	L	L	L	L	L/M	L	L	M	L/M	L	L/M	L	L	L	L/M	1	L/M	L/M	H	1
LACUSTRINE/SLACKWATER PLAIN	SILT, CLAY	M/L	M	M/L	M/H	M	L/M	1	H/M	H	H	M/H	H	H	L	M	H	M	M/H	M/H	H	M	M	H	H	M/L	M	1	M	H	H	1
SLACKWATER TERRACE	SILT, CLAY, SAND	H	L	M/L	H	M	L	1	H/M	H	H	H	H	M	L	M	H	M	M/H	H	H	M	M	H	H	M/L	M	1	M	H	H	1
FLOOD PLAIN	SAND, SILT, CLAY	M	M	H	L/M	M	M	1-3	M	M	M/L	M/H	H/L	M/H	L	M	M	M/L	L	M/H	M	H	L/M	L/M	M	H	M	2	L	M	H	2
RIVER TERRACE	SILT, CLAY, SAND, GRAVEL	M	M/H	M	L	L	M	2	M/H	M/H	L/M	L/M	H	M/H	L	L	L/M	L/M	L	H/M	H/M	L	L/M	M	L/M	L	L	2	L/M	M	L/M	2
OUTWASH TERRACE	SAND,GRAVEL	L	M/H	M	L	L	M	3	L	L	L	L	L	L/M	L	L	L/M	L	L	L	L	L	L	L	L	L	L	3	L/M	L/M	L	3
ORGANIC DEPOSITS	MUCK,MARL,PEAT	H	L	H	H	H	H	1-3	H	H	H	H	H	H	L	L	L	H	H	H	H	H	M	M	H	H	H	1	H	H	H	1

behavior were not considered in the development of Table 7, which is based on the average landform-parent material behavior.

In the early stages of foundation or embankment design it may be useful to quantitatively identify potential problems with bearing capacity, settlement, or slope stability. Many correlations exist for determining shear strength and compressibility parameters used in these analyses. Relationships between these parameters and classification test results such as Atterburg limits, grain size, density, and penetration resistance are most common in the literature. Figures 23 and 24 give correlations for shear strength parameters. Figure 23 illustrates the angle of shearing resistance versus plasticity index for fine grain soils, and the angle of internal friction versus density for coarse grained soils (29). Figure 24 correlates standard penetration resistance (SPT N-value) to relative density of sand and unconfined compressive strength of clay (29). Settlement parameters can also be approximated. Many correlations exist for the compression index (i.e. Cc=0.009[LL-10]), recompression index, and coefficient of secondary compression for silts, clays, and organic soils. Correlations also exist for the elastic modulus needed in immediate settlement calculations. However, these are usually based more on regional experience with a given deposit, and therefore are not presented here.

Finally, Table 8 (Typical Properties of Compacted Materials) is given for preliminary design analyses of compacted embankments and earth dams.

These relationships have many limitations and are only suitable for preliminary estimates; however, they can be very helpful in identifying potential problems.

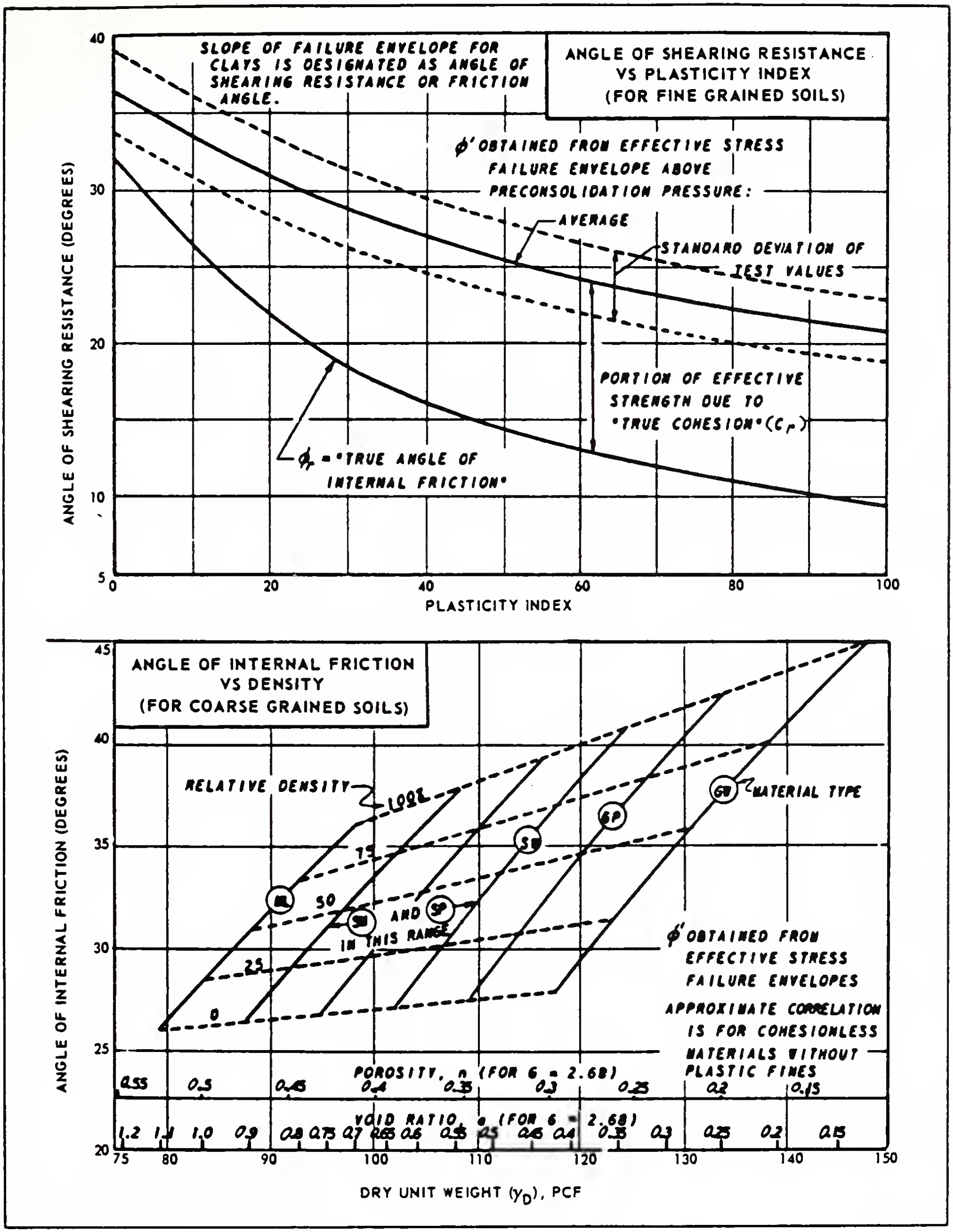


FIGURE 23. CORRELATIONS FOR STRENGTH PARAMETERS (29).

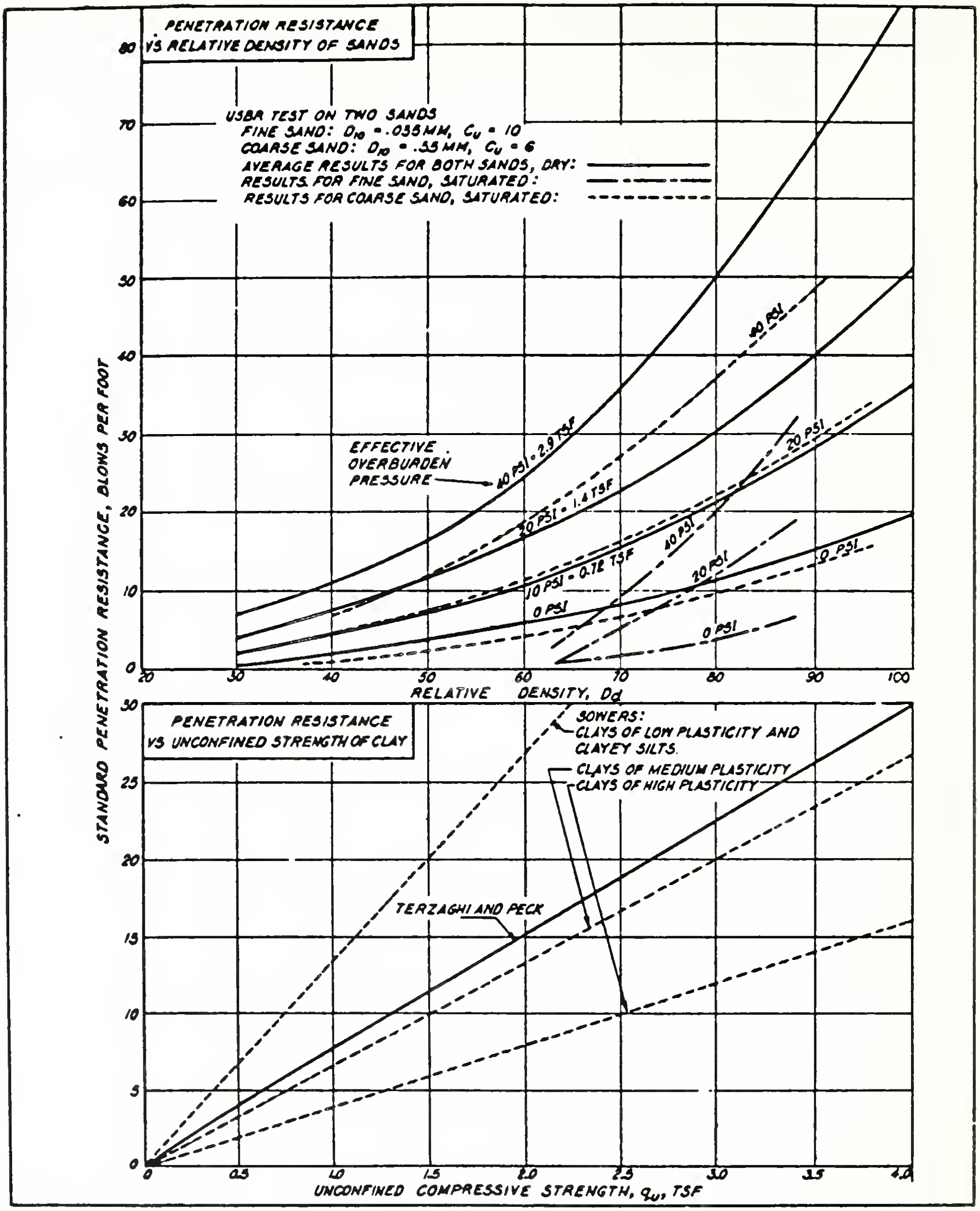


FIGURE 24. CORRELATIONS OF STANDARD PENETRATION RESISTANCE (29).

TABLE 8. TYPICAL PROPERTIES OF COMPACTED MATERIALS (29).

Group symbol	Soil type	Range of maximum dry unit weight, pcf	Range of optimum moisture, percent	Typical value of compression: At 1.4 tsf (20 psi)	Typical value of compression: At 3.6 tsf (50 psi)	Typical strength characteristics: Cohesion (as compacted) psf	Cohesion (saturated) psf	ϕ(Effective stress envelope) degrees	Tan ϕ	Typical coefficient of permeability ft/min.	Range of CBR values	Range of subgrade modulus k lb/cu in
				percent of original height								
GW	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
GP	Poorly graded clean gravels, gravel-sand mix.	115 - 125	14 - 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	....	....	>34	>0.67	$>10^{-6}$	20 - 60	100 - 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.6	....	....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	5×10^{-5}	10 - 40	100 - 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	2×10^{-6}	....	
SC	Clayey sands, poorly graded sand-clay mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	5×10^{-7}	5 - 20	100 - 300
ML	Inorganic silts and clayey silts .	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	10^{-5}	15 or less	100 - 200
ML-CL	Mixture of inorganic silt and clay	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	5×10^{-7}	....	
CL	Inorganic clays of low to med. plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	10^{-7}	15 or less	50 - 200
OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	....	....	....	....	....	.....	....	5 or less	50 - 100
MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	5×10^{-7}	10 or less	50 - 100
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	10^{-7}	15 or less	50 - 150
OH	Organic clays and silty clays . . .	65 - 100	45 - 21	....	....	....	....	....	.....	....	5 or less	25 - 100

Notes:

1. All properties are for condition of "standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
(....) indicates insufficient data available for an estimate.

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APPENDIX A

CLASSIFICATION TEST RESULTS FOR SELECTED ENGINEERING PROJECTS IN KNOX COUNTY (41-56)

APPENDIX A. CLASSIFICATION TEST RESULTS FOR SELECTED ENGINEERING PROJECTS IN KNOX COUNTY (41-56).

PROJECT	BOR NO.	SAMPLE NO.	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				LL	PL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
US 41	1	1	196+00	CL	500.5	0.5-2.0	Silty clay	A-7-6(12)	0.0	2.1	62.9	35.0	43.0	23.3	19.7
"	2	1	215+00	50 L	466.9	0.5-5.5	Sandy loam	A-4(3)	0.0	51.4	36.2	12.4	21.4	18.4	3.0
"	2	2	215+00	50 L	466.9	5.5-7.0	Silty loam	A-4(7)	0.0	28.4	55.0	16.6	28.5	24.4	4.1
"	3	1	269+00	42 L	448.0	0.0-1.0	Clay loam	A-4(7)	0.0	32.3	45.7	22.0	21.8	18.6	3.2
"	3	2	269+00	42 L	448.0	1.0-4.0	Clay loam	A-4(6)	0.0	36.1	41.4	22.5	25.1	16.1	9.0
"	3	3	269+00	42 L	448.0	4.0-6.5	Sand	A-2-4(0)	0.0	85.7	7.3	7.0	NP	NP	NP
"	4	1	322+50	42 L	479.4	0.5-4.0	Sand	A-2-4(0)	0.0	83.1	8.3	8.6	NP	NP	NP
"	4	2	322+50	42 L	479.4	4.0-5.0	Silty loam	A-4(3)	0.0	41.7	50.4	7.9	21.1	20.7	0.4
"	4	3	322+50	42 L	479.4	5.0-7.5	Sand	A-2-4(0)	0.0	85.6	10.5	3.9	NP	NP	NP
"	4	4	322+50	42 L	479.4	7.5-8.0	Silt	A-4(8)	0.0	11.5	80.5	8.0	21.1	22.9	NP
"	5	1	378+50	42 R	424.1	0.0-0.5	Sandy loam	A-2-4(0)	0.0	73.0	12.0	15.0	NP	NP	NP
"	5	2	378+50	42 R	424.1	0.5-3.0	Sandy loam	A-2-4(0)	0.0	78.6	10.3	11.1	NP	NP	NP
"	5	3	378+50	42 R	424.1	3.0-5.5	Sand	A-2-4(0)	0.0	88.6	3.1	8.3	NP	NP	NP
"	5	4	378+50	42 R	424.1	5.5-7.0	Sand	A-1-b	8.6	77.4	4.4	9.6	NP	NP	NP
"	6	1	397+00	42 L	429.9	0.0-1.0	Sandy loam	A-2-4(0)	0.0	79.8	9.9	10.3	NP	NP	NP
"	6	2	397+00	42 L	429.9	1.0-2.0	Sandy loam	A-2-4(0)	0.0	73.4	15.1	11.5	NP	NP	NP
"	6	3	397+00	42 L	429.9	2.0-4.0	Sand	A-2-4(0)	0.0	84.8	5.7	9.5	NP	NP	NP
"	7	1	412+00	42 R	428.3	0.0-2.5	Sandy clay loam	A-4(2)	0.0	56.7	21.1	22.2	22.5	15.5	6.9
"	8	1	427+00	50 L	430.8	0.0-1.5	Sandy loam	A-2-4(0)	0.0	76.2	13.4	10.4	NP	NP	NP
"	8	2	427+00	50 L	430.8	1.5-3.5	Sandy loam	A-2-4(0)	2.5	64.0	19.0	14.5	NP	NP	NP
"	8	3	427+00	50 L	430.8	5.0-6.5	Sandy loam	A-2-4(0)	0.0	78.5	8.2	13.3	NP	NP	NP
"	9	1	447+50	42 R	440.2	0.0-3.0	Sandy loam	A-4(1)	0.0	62.0	25.0	13.0	NP	NP	NP
"	9	2	447+50	42 R	440.2	3.0-5.0	Sand	A-2-4(0)	0.0	82.5	6.7	10.8	NP	NP	NP
"	9	3	447+50	42 R	440.2	5.0-6.0	Clay loam	A-6(5)	0.0	38.1	38.9	23.0	27.5	16.7	10.8
"	10	1	457+70	CL	444.0	0.0-3.0	Clay loam	A-6(8)	0.0	34.4	36.8	28.7	35.5	19.3	16.2
"	10	2	457+70	CL	444.0	3.0-7.0	Clay	A-6(11)	0.0	31.8	37.2	31.0	36.4	16.4	20.0
"	11	1	482+00	42 R	445.2	0.0-1.0	Loam	A-4(4)	0.0	43.4	40.3	16.3	18.6	15.9	2.7
"	11	2	482+00	42 R	445.2	1.0-4.0	Sandy Loam	A-4(2)	0.0	54.0	26.5	19.5	23.3	16.4	6.9
"	11	3	482+00	42 R	445.2	4.0-6.0	Sandy clay loam	A-4(0)	0.0	63.1	11.9	25.0	25.6	17.0	8.6
"	12	1	540+00	65 R	491.6	0.0-1.5	Silty clay loam	A-6(9)	0.0	3.1	73.4	23.5	36.7	23.1	13.6
"	12	2	540+00	65 R	491.6	1.5-6.0	Silt	A-4(8)	0.0	1.4	85.1	13.5	27.2	24.2	3.0
"	13	1	572+00	42 R	486.7	0.5-2.0	Clay loam	A-4(6)	0.0	35.8	41.2	23.0	27.4	18.8	8.6
"	13	2	572+00	42 R	486.7	2.5-3.5	Clay loam	A-6(9)	0.0	28.6	42.9	28.5	34.1	18.2	15.9
"	13	3	572+00	42 R	486.7	3.5-6.0	Sandy loam	A-2-4(0)	0.0	67.8	27.2	5.0	NP	NP	NP
"	14	1	621+50	42 L	471.2	0.0-1.0	Loam	A-4(5)	0.0	42.4	38.1	19.5	26.4	16.9	9.5
"	14	2	621+50	42 L	471.2	1.0-2.0	Clay	A-7-6(11)	0.0	41.1	21.8	37.1	43.0	19.5	23.5
"	14	3	621+50	42 L	471.2	2.0-3.5	Clay	A-7-6(15)	0.0	37.4	24.6	38.0	45.5	13.9	31.6
"	14	4	621+50	42 L	471.2	3.5-6.0	Sandy loam	A-2-4(0)	0.0	65.7	26.2	8.1	NP	NP	NP
"	15	1	51+00	CL	483.3	0.0-1.0	Clay	A-7-6(10)	0.0	28.7	41.1	30.2	40.7	22.5	18.2
"	15	2	51+00	CL	483.3	2.0-3.5	Clay	A-7-6(15)	0.0	22.7	44.2	33.1	44.3	20.3	24.0
"	15	3	51+00	CL	483.3	4.5-6.0	Silty loam	A-4(7)	0.0	32.9	57.4	9.7	21.3	19.1	2.2
"	16	1	726+75	42 L	485.3	0.0-1.0	Sandy loam	A-4(1)	0.0	57.7	32.0	10.3	NP	NP	NP

APPENDIX A (CONTINUED)

PROJECT	BOR NO.	SAMPLE NO.	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				LL	PL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
"	16	2	726+75	42 L	485.3	1.5-3.0	Clay loam	A-4(5)	0.0	42.0	36.3	21.7	22.5	16.0	6.5
"	16	3	726+75	42 L	485.3	3.5-6.0	Sand	A-2-4(0)	0.0	87.6	5.3	7.1	NP	NP	NP
"	17	1	731+50	42 L	480.8	1.5-3.5	Clay	A-7-6(20)	0.0	11.6	29.8	38.6	70.2	25.6	44.6
"	18	1	766+00	42 L	471.4	1.0-3.5	Sandy loam	A-2-4(0)	0.0	78.7	12.5	8.8	NP	NP	NP
"	19	1	277+00	CL	516.0	11.0-13.5	Clay	A-6(11)	0.0	0.0	38.0	62.0	38.3	21.1	17.2
"	20	1	345+00	CL	490.4	9.0-23.5	Silt	A-4(8)	0.0	12.6	81.4	6.0	22.5	NP	NP
"	21	1	556+00	42 R	419.8	5.5-20.5	Silt	A-4(8)	0.0	3.5	81.5	15.0	25.5	22.4	3.1
US 41	22	1	639+00	37 L	409.5	1.0-2.0	Sandy loam	A-2-4(0)	0.0	72.0	15.0	13.0	NP	NP	NP
"	22	2	639+00	37 L	409.5	5.0-6.0	Clay	A-7-6(20)	0.0	16.0	43.0	41.0	65.0	25.0	40.0
"	23	1	654+00	37 L	407.8	1.0-2.0	Clay loam	A-6(10)	0.0	33.0	46.0	21.0	39.0	21.0	18.0
"	23	2	654+00	37 L	407.8	2.0-3.0	Clay	A-7-6(15)	0.0	30.0	33.0	37.0	44.0	17.0	27.0
"	23	3	654+00	37 L	407.8	5.0-6.0	Clay	A-6(9)	0.0	40.0	30.0	30.0	36.0	17.0	19.0
"	24	1	666+00	37 R	406.8	9.0-10.0	Sandy loam	A-2-4(0)	0.0	76.0	20.0	4.0	NP	NP	NP
"	25	1	689+00	37 R	406.8	1.0-2.0	Clay	A-7-6(15)	0.0	41.0	29.0	30.0	51.0	21.0	31.0
"	25	2	689+00	37 R	406.8	5.0-6.0	Clay loam	A-7-6(15)	0.0	33.0	39.0	28.0	46.0	19.0	27.0
"	26	1	700+00	37 R	406.7	0.0-1.0	Clay	A-6(8)	0.0	42.0	26.0	32.0	37.0	20.0	17.0
"	27	1	706+00	37 R	406.8	5.0-6.0	Sandy loam	A-2-4(0)	0.0	77.0	12.0	11.0	NP	NP	NP
"	28	1	728+00	37 R	407.0	0.5-2.8	Sandy loam	A-2-4(0)	0.0	72.0	13.0	15.0	NP	NP	NP
"	29	1	742+00	37 R	406.0	0.0-1.0	Sandy clay	A-7-6(8)	0.0	57.0	11.0	32.0	53.0	22.0	31.0
"	29	2	742+00	37 R	406.0	4.0-5.0	Sand	A-1-b(0)	0.0	89.0	8.0	3.0	NP	NP	NP
"	30	1	748+00	37 R	407.4	0.0-1.0	Sandy loam	A-2-4(0)	0.0	79.0	7.0	14.0	NP	NP	NP
"	31	1	779+00	37 R	407.6	4.0-5.0	Clay loam	A-6(7)	0.0	38.0	39.0	23.0	28.0	16.0	12.0
"	32	1	783+40	37 R	404.4	1.0-2.0	Loam	A-6(5)	0.0	42.0	43.0	15.0	33.0	22.0	11.0
"	33	1	798+00	37 R	406.9	1.0-4.0	Sandy loam	A-2-6(1)	0.0	67.0	14.0	19.0	31.0	16.0	15.0
"	33	2	798+00	37 R	406.9	4.0-6.0	Sand	A-1-b(0)	0.0	88.0	7.0	5.0	NP	NP	NP
"	34	1	815+00	37 R	407.2	5.0-6.0	Sand	A-2-4(0)	0.0	85.0	2.0	13.0	NP	NP	NP
"	35	1	836+00	37 R	407.5	0.8-4.8	Sandy clay loam	A-6(5)	0.0	55.0	18.0	27.0	38.0	18.0	20.0
"	36	1	847+00	37 R	409.0	1.0-3.0	Clay loam	A-7-6(10)	0.0	45.0	26.0	29.0	43.0	19.0	24.0
"	36	2	847+00	37 R	409.0	4.5-5.5	Sandy clay loam	A-6(6)	0.0	53.0	19.0	28.0	36.0	15.0	21.0
"	36	3	847+00	37 R	409.0	6.0-8.0	Sand	A-2-4(0)	0.0	90.0	4.0	6.0	NP	NP	NP
"	37	1	858+00	37 R	410.5	3.0-4.0	Sandy clay loam	A-6(3)	0.0	59.0	19.0	22.0	27.0	15.0	12.0
"	38	1	876+00	37 R	412.3	5.0-6.0	Clay	A-7-6(15)	0.0	31.0	34.0	35.0	46.0	19.0	27.0
"	39	1	886+00	37 R	412.3	1.0-2.0	Silty loam	A-4(6)	0.0	35.0	51.0	14.0	24.0	18.0	6.0
"	39	2	886+00	37 R	412.3	9.0-10.0	Sand	A-1-b(0)	0.0	87.0	8.0	5.0	NP	NP	NP
"	40	1	912+00	37 R	411.6	1.0-2.0	Loam	A-4(7)	0.0	33.0	48.0	19.0	26.0	18.0	8.0
"	40	2	912+00	37 R	411.6	5.0-6.0	Sandy clay loam	A-6(4)	0.0	52.0	26.0	22.0	30.0	15.0	15.0
"	41	1	927+00	47 R	411.7	1.0-2.0	Sandy loam	A-4(3)	0.0	51.0	33.0	16.0	24.0	16.0	8.0
"	42	1	935+00	42 L	409.4	7.0-8.0	Sand	A-2-6(0)	0.0	80.0	11.0	9.0	25.0	14.0	11.0
"	43	1	941+00	37 L	409.5	5.5-6.0	Clay	A-7-6(14)	0.0	17.0	53.0	30.0	43.0	20.0	23.0
"	44	1	943+00	37 L	408.4	5.0-6.0	Clay	A-7-6(15)	0.0	20.0	45.0	35.0	45.0	20.0	25.0
"	44	2	943+00	37 L	408.4	6.0-7.0	Clay	A-7-5(20)	0.0	26.0	43.0	31.0	75.0	44.0	31.0
"	45	1	947+00	55 R	410.1	8.5-10.0	Sandy loam	A-2-4(0)	0.0	77.0	15.0	8.0	NP	NP	NP
"	46	1	949+00	37 L	408.5	5.0-6.0	Clay	A-7-6(17)	0.0	21.0	43.0	36.0	50.0	23.0	27.0
US 41	47	1	542+00	37 L	412.1	7.5-9.0	Gravelly sand	A-1-a(0)	65.0	33.0	1.0	1.0	-	-	-

APPENDIX A (CONTINUED)

PROJECT	BOR NO.	SAMPLE NO.	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				LL	PL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
"	48	1	545+00	37 R	415.6	1.0-2.0	Sandy loam	A-4(1)	0.0	58.0	31.0	11.0	NP	NP	NP
"	49	1	553+00	37 R	459.4	9.0-10.0	Sandy loam	A-2-4(0)	0.0	73.0	24.0	3.0	–	–	–
"	50	1	556+00	37 L	439.5	1.0-2.0	Clay	A-6(10)	1.0	25.0	39.0	35.0	34.0	19.0	15.0
"	51	1	565+00	37 R	415.8	9.5-10.5	Sandy clay loam	A-4(3)	0.0	52.0	28.0	20.0	17.0	14.0	3.0
"	52	1	568+00	37 L	411.8	1.0-2.0	Sandy loam	A-6(0)	23.0	41.0	20.0	16.0	27.0	16.0	11.0
"	53	1	571+00	37 R	411.8	12.0-13.5	Loam	A-4(4)	10.0	34.0	39.0	17.0	23.0	19.0	4.0
"	54	1	575+50	37 R	411.6	10.0-11.5	Sand	A-2-4(0)	18.0	67.0	14.0	1.0	–	–	–
"	55	1	580+00	37 L	415.5	1.0-2.0	Sandy clay loam	A-6(3)	24.0	31.0	22.0	23.0	34.0	20.0	14.0
"	56	1	583+00	37 R	416.9	5.0-6.0	Sand	A-1-b(0)	8.0	74.0	13.0	5.0	–	–	–
"	57	1	586+00	37 L	418.7	5.0-6.0	Sandy loam	A-2-4(0)	5.0	72.0	11.0	12.0	–	–	–
"	58	1	590+00	37 L	417.6	7.5-9.0	Sandy loam	A-4(1)	10.0	48.0	27.0	15.0	19.0	15.0	4.0
"	59	1	592+00	37 L	418.0	1.0-2.0	Clay	A-7-6(15)	0.0	18.0	39.0	43.0	50.0	28.0	22.0
"	60	1	593+00	37 R	419.3	3.0-4.5	Clay loam	A-6(6)	0.0	34.0	42.0	24.0	30.0	19.0	11.0
"	61	1	605+00	71 L	434.1	16.5-17.5	Silt	A-7-5(13)	0.0	6.0	86.0	8.0	54.0	39.0	15.0
"	61	2	605+00	71 L	434.1	34.0-35.5	Silt	A-4(8)	0.0	1.0	92.0	7.0	NP	NP	NP
"	61	3	605+00	71 L	434.1	39.0-40.5	Sand	A-1-b(0)	12.0	81.0	5.0	2.0	–	–	–
"	62	1	606+75	37 L	439.5	5.5-6.5	Silt	A-4(8)	0.0	2.0	94.0	4.0	NP	NP	NP
"	62	2	606+75	37 L	439.5	14.5-16.0	Silty clay loam	A-4(8)	0.0	3.0	71.0	26.0	34.0	24.0	10.0
"	63	1	609+50	37 R	461.7	7.0-8.0	Sand	A-2-4(0)	0.0	82.0	6.0	12.0	–	–	–
"	64	1	462+50	37 R	472.0	3.0-4.0	Clay loam	A-4(4)	0.0	45.0	30.0	25.0	24.0	14.0	10.0
"	64	2	462+50	37 R	472.0	9.0-10.0	Silty clay loam	A-4(8)	0.0	15.0	63.0	22.0	25.0	19.0	6.0
"	65	1	464+45	37 L	483.6	1.0-4.0	Clay loam	A-4(5)	2.0	39.0	38.0	21.0	26.0	17.0	9.0
"	65	2	464+45	37 L	483.6	6.0-10.0	Sandy loam	A-2-4(0)	11.0	68.0	11.0	10.0	NP	NP	NP
"	65	3	464+45	37 L	483.6	12.0-13.0	Sandy loam	A-2-4(0)	8.0	67.0	9.0	16.0	19.0	15.0	4.0
"	66	1	475+00	37 L	473.1	7.0-8.0	Sandy loam	A-2-4(0)	0.0	79.0	7.0	14.0	–	–	–
"	67	1	477+00	37 R	479.9	5.0-7.0	Sand	A-3(0)	0.0	92.0	3.0	5.0	NP	NP	NP
"	68	1	478+00	37 R	462.6	1.0-1.0	Sand	A-2-4(0)	0.0	84.0	8.0	8.0	–	–	–
"	69	1	480+50	37 R	468.8	8.0-9.0	Sand	A-2-4(0)	0.0	88.0	9.0	3.0	–	–	–
"	70	1	483+50	37 R	446.4	5.0-6.0	Silty clay loam	A-6(9)	0.0	17.0	57.0	26.0	32.0	19.0	13.0
"	71	1	484+00	CL	446.3	10.5-12.0	Silty loam	A-4(6)	0.0	36.0	51.0	13.0	27.0	26.0	1.0
"	72	1	486+00	100L	445.8	6.0-7.0	Silty loam	A-4(8)	0.0	22.0	63.0	15.0	24.0	20.0	4.0
"	72	2	486+00	100L	445.8	8.0-9.0	Sand	A-2-4(0)	0.0	81.0	12.0	7.0	–	–	–
"	73	1	486+00	130R	445.8	12.0-13.0	Silty clay loam	A-4(8)	0.0	2.0	73.0	25.0	23.0	20.0	3.0
"	74	1	4+00	CL	415.6	5.0-6.0	Gravelly sand	A-1-b(0)	31.0	58.0	7.0	4.0	NP	NP	NP
"	74	2	4+00	CL	415.6	9.0-10.0	Sand	A-3(0)	20.0	72.0	5.0	3.0	–	–	–
"	75	1	7+00	CL	415.9	1.0-2.0	Loam	A-4(3)	5.0	44.0	35.0	16.0	18.0	15.0	3.0
"	75	2	7+00	CL	415.9	4.0-5.0	Sandy loam	A-2-6(1)	30.0	48.0	8.0	14.0	39.0	16.0	23.0
"	76	1	10+00	CL	422.0	7.0-8.0	Silty clay loam	A-6(10)	1.0	13.0	59.0	27.0	37.0	22.0	15.0
"	77	1	10+00	CL	424.8	3.0-4.0	Sandy clay loam	A-4(2)	0.0	54.0	25.0	21.0	22.0	15.0	7.0
"	78	1	17+00	12 R	422.0	8.0-9.0	Clay	A-6(10)	11.0	18.0	37.0	34.0	38.0	21.0	17.0
"	79	1	105+00	12 R	485.1	5.0-6.0	Gravelly sand	A-1-b(0)	40.0	50.0	6.0	4.0	–	–	–
SR 58	80	1	87+00	14 R	540.87	1.0-2.5	Gravelly sand	A-2-4(0)	36.1	47.3	16.6	0.0	24.0	16.5	7.5
"	80	2	87+00	14 R	540.87	3.5-5.0	Clay loam	A-4(3)	11.9	18.5	42.6	27.0	29.3	22.8	6.5
"	80	3	87+00	14 R	540.87	6.0-7.5	Silty clay	A-4(8)	0.4	7.0	62.2	30.5	30.2	21.2	9.0

APPENDIX A (CONTINUED)

PROJECT	BOR NO.	SAMPLE NO.	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				LL	PL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
"	80	4	87+00	14 R	540.87	11.0-12.5	Clay loam	A-6(7)	0.4	25.5	47.5	26.6	29.7	17.3	12.4
"	80	5	87+00	14 R	540.87	13.5-15.0	Silty loam	A-6(6)	1.4	24.9	56.7	17.0	29.1	18.2	10.9
SR 67	81	1	514+32	23 L	569.7	3.5-5.0	Sandy loam	A-2-4(0)	0.2	66.1	20.2	13.5	20.0	15.0	5.0
Grader	81	2	514+32	23 L	569.7	18.5-20.0	Sand	A-3(0)	1.2	92.3	6.5	—	NP	NP	NP
Ditch	82	1	514+74	21 R	469.0	3.0-6.0	Silty clay loam	A-6(15)	2.3	5.6	68.4	23.7	35.0	18.0	17.0
"	83	1	516+40	32 R	462.0	3.5-5.0	Sandy clay loam	A-6(3)	0.3	57.8	19.5	22.4	30.0	11.0	19.0
SR 67	84	1	75+91	22 L	447.0	1.0-3.0	Silty loam	A-4(7)	0.1	9.0	73.9	17.0	29.0	20.0	9.0
Purdy	84	2	75+91	22 L	447.0	13.5-15.0	Sand	A-3(0)	0.1	93.5	6.4	—	NP	NP	NP
Marsh	84	3	75+91	22 L	447.0	23.5-25.0	Gravelly sand	A-1-b(0)	29.9	56.4	13.7	—	NP	NP	NP
Ditch	84	4	75+91	22 L	447.0	38.5-40.0	Silty clay	A-6(12)	0.0	0.4	69.6	30.0	32.0	20.0	12.0
"	84	5	75+91	22 L	447.0	58.5-59.9	Loam	A-4(0)	19.3	30.0	40.5	10.2	24.0	19.0	5.0
SR 67	85	1	39+11	23 L	450.0	5.0-8.0	Clay	A-7-6(34)	0.0	0.6	33.7	65.7	54.0	24.0	30.0
Miller	86	1	39+71	13 L	452.3	23.5-25.0	Sand	A-3(0)	0.0	93.7	6.3	—	NP	NP	NP
Ditch	87	1	39+81	22 R	450.0	3.5-5.0	Silty loam	A-4(2)	0.2	17.5	68.6	13.7	25.0	21.0	4.0
"	87	2	39+81	22 R	450.0	13.5-15.0	Clay	A-6(18)	0.0	0.8	43.9	55.3	39.0	23.0	16.0
SR 67	88	1	340+96	26 L	454.3	2.5-5.0	Silty clay loam	-	-	-	-	-	-	-	-
Smalls	88	2	340+96	26 L	454.3	15.0-16.5	Shale	-	-	-	-	-	-	-	-
Creek	89	1	341+80	33 R	449.8	1.0-2.5	Silty clay loam	-	-	-	-	-	-	-	-
"	89	2	341+80	33 R	449.8	8.5-10.0	Silty clay loam	-	-	-	-	-	-	-	-
"	89	3	341+80	33 R	449.8	23.5-25.0	Silt	-	-	-	-	-	-	-	-
CR 397	90	1	16+35	14 L	461.0	18.5-20.0	Gravelly sand	A-3(0)	30.0	65.0	5.0	—	NP	NP	NP
Black	91	1	18+25	14 R	461.0	1.0-2.5	Loam	A-4(2)	0.0	46.0	37.0	17.0	24.0	15.0	9.0
Creek	91	2	18+25	14 R	461.0	8.5-10.0	Clay loam	A-6(5)	0.0	40.0	37.0	23.0	29.0	15.0	14.0
SR 358	92	1	11+00	CL	464.9	1.0-2.0	Silty loam	A-4(3)	0.0	18.0	68.0	14.0	23.1	17.2	5.9
White	92	2	11+00	CL	464.9	2.0-6.0	Silty loam	A-6(10)	0.0	15.0	67.0	18.0	30.4	16.9	13.5
River	93	1	15+00	CL	453.9	1.0-3.0	Silty loam	A-6(7)	0.0	19.0	65.0	16.0	29.0	18.4	10.6
"	94	1	18+00	CL	450.5	2.5-3.5	Silty clay loam	A-4(5)	0.0	5.0	74.0	21.0	27.4	20.8	6.6
"	94	2	18+00	CL	450.5	9.0-11.0	Silty loam	A-4(1)	0.0	17.0	72.0	11.0	24.3	21.4	2.9
"	95	1	18+60	17 L	453.5	2.5-4.0	Silty loam	A-4(3)	0.0	23.0	69.0	8.0	26.8	21.4	5.4
"	95	2	18+60	17 L	453.5	7.5-9.5	Silty loam	A-4(1)	0.0	27.0	62.0	11.0	23.8	20.1	3.7
"	95	3	18+60	17 L	453.5	15.0-16.5	Silty loam	A-4(1)	0.0	34.0	57.0	9.0	24.7	19.9	4.8
"	95	4	18+60	17 L	453.5	20.0-21.5	Silty loam	A-4(0)	0.0	20.0	67.0	13.0	24.8	22.8	2.0
US 50	96	1	775+00	12 L	441.5	0.5-2.0	Clay	A-6(15)	0.0	8.0	46.0	46.0	34.0	17.0	17.0
White	97	1	777+73	42 L	425.0	3.5-5.0	Loam	A-4(0)	0.0	44.0	42.0	14.0	28.0	23.0	5.0
River	98	1	778+06	65 R	441.5	13.5-15.0	Silty loam	A-4(2)	0.0	36.0	54.0	10.0	25.0	22.0	3.0
"	99	1	808+64	44 L	425.5	2.0-3.5	Silty loam	A-6(14)	0.0	2.0	80.0	18.0	35.0	21.0	14.0
"	99	2	808+64	44 L	425.5	8.5-10.0	Sand	A-1-b(0)	8.0	89.0	3.0	—	NP	NP	NP
"	99	3	880+64	44 L	425.5	48.5-50.0	Sandy loam	A-4(0)	12.0	47.0	32.0	9.0	20.0	16.0	4.0
"	100	1	830+51	42 L	432.3	18.5-20.0	Sand	A-3(1)	1.0	96.0	2.0	1.0	NP	NP	NP
"	101	1	832+74	42 L	428.3	33.5-35.0	Silty clay loam	A-6(8)	0.0	18.0	54.0	28.0	31.0	20.0	11.0
US 50	102	1	743+08	24 R	431.1	15.0-16.5	Sand	A-3(0)	1.0	91.0	6.0	2.0	NP	NP	NP
Dunn	102	2	743+08	24 R	431.1	30.0-31.5	Silty clay loam	A-4(5)	3.0	20.0	56.0	21.0	27.5	18.4	9.1
Ditch	102	3	743+08	24 R	431.1	40.0-41.5	Clay	A-7-6(40)	0.0	0.0	29.0	71.0	57.5	22.3	35.2
"	103	1	743+44	24 L	430.5	5.0-6.5	Silty Clay	A-6(20)	1.0	4.0	63.0	32.0	40.3	20.9	19.4

APPENDIX A (CONTINUED)

PROJECT	BOR NO.	SAMPLE NO.	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				LL	PL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
"	103	2	743+44	24 L	430.5	10.0-11.5	Loam	A-4(0)	0.0	45.0	47.0	8.0	NP	NP	NP
CR 17	104	1	58+11	14 R	424.5	8.5-10.0	Sand	A-3(0)	0.0	98.0	2.0	—	NP	NP	NP
Plass	104	2	58+11	14 R	424.5	33.5-35.0	Gravelly Sand	A-1-b(0)	26.0	70.0	4.0	—	NP	NP	NP
Ditch	105	1	58+49	20 L	420.0	1.0-2.5	Sandy Loam	A-4(0)	0.0	54.0	27.0	19.0	25.0	24.0	1.0
"	106	1	58+95	14 R	426.0	1.0-2.5	Silty loam	A-4(0)	0.0	18.0	73.0	9.0	NP	NP	NP
SR 61	107	1	99+77	53 L	411.0	0.0-2.0	Sand	-	-	-	-	-	-	-	-
Swan	107	2	99+77	53 L	411.0	2.0-18.8	Sandstone	-	-	-	-	-	-	-	-
Pond	108	1	100+36	40 R	417.0	3.5-5.0	Clay loam	-	-	-	-	-	-	-	-
Ditch	108	2	100+36	40 R	417.0	9.0-28.7	Sandstone	-	-	-	-	-	-	-	-
SR 61	109	1	137+15	105 R	424.2	1.0-2.5	Loam	A-4(0)	0.0	42.2	49.1	8.7	NP	NP	NP
White	109	2	137+15	105 R	424.2	3.5-5.0	Sandy loam	A-4(0)	0.0	51.7	40.4	7.9	NP	NP	NP
River	109	3	137+15	105 R	424.2	8.5-10.0	Sandy loam	A-4(0)	0.0	58.0	33.0	9.0	NP	NP	NP
Over-	109	4	137+15	105 R	424.2	18.5-20.0	Silty clay loam	A-4(8)	0.0	5.7	70.4	23.9	28.1	18.7	9.4
flow	109	5	137+15	105 R	424.2	28.5-30.0	Clay	A-7-6(20)	0.4	4.3	39.4	55.9	41.3	22.0	19.3
"	110	1	138+00	95 R	420.4	33.5-35.0	Loam	A-4(6)	0.3	47.3	34.5	17.9	20.2	15.7	4.5
"	111	1	138+86	95 R	422.2	28.5-30.0	Clay	A-7-6(26)	0.0	0.5	34.1	65.4	45.8	22.3	23.5
"	111	2	138+86	95 R	422.2	36.5-38.8	Sandy shale	-	-	-	-	-	-	-	-
"	112	1	138+90	75 L	421.2	17.0-23.8	Shale	-	-	-	-	-	-	-	-
SR 67	113	1	409+78	22 L	512.5	6.0-7.5	Silty loam	A-4(1)	1.8	30.1	52.6	15.5	22.0	17.0	5.0
at	114	1	234+30	30 L	513.5	2.5-6.5	Silty clay loam	A-7-6(22)	0.5	1.3	69.9	28.3	41.0	20.0	21.0
SR 550	115	1	237+00	57 R	490.8	7.0-7.5	Sandy loam	A-2-4(0)	0.0	70.4	23.5	6.1	NP	NP	NP

APPENDIX B

PHYSICAL AND CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN KNOX COUNTY (2)

APPENDIX B. PHYSICAL AND CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN KNOX COUNTY (2).

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
AdB	0-17	3-12	1.35-1.55	6.0-20	0.10-0.12	5.1-6.5	Low	0.17	5	2	3-5
Ade	17-32	3-12	1.40-1.60	6.0-20	0.06-0.08	5.1-6.0	Low	0.17			
	32-65	3-16	1.40-1.60	6.0-20	0.06-0.08	5.1-6.0	Low	0.17			
	65-70	1-8	1.50-1.70	6.0-20	0.06-0.08	6.1-8.4	Low	0.17			
AlA, AlB2, AlC2	0-6	18-27	1.25-1.40	0.6-2.0	0.22-0.24	3.6-7.3	Low	0.37	5	5	.5-2
Alford	6-72	22-30	1.35-1.50	0.6-2.0	0.18-0.20	3.6-6.0	Moderate	0.37			
	72-80	8-20	1.30-1.45	0.6-2.0	0.20-0.22	4.5-7.3	Low	0.37			
AlD3	0-4	18-27	1.25-1.40	0.6-2.0	0.22-0.24	3.6-7.3	Low	0.37	5	5	.5-2
Alford	4-64	22-30	1.35-1.50	0.6-2.0	0.18-0.20	3.6-6.0	Moderate	0.37			
	64-70	8-20	1.30-1.45	0.6-2.0	0.20-0.22	4.5-7.3	Low	0.37			
AnB, AnC, AnD	0-16	10-15	1.45-1.65	2.0-6.0	0.14-0.20	5.1-6.5	Low	0.24	5	3	.5-1
Alvin	16-54	15-18	1.45-1.65	0.6-2.0	0.12-0.20	4.5-6.0	Low	0.24			
	54-60	3-10	1.55-1.75	6.0-20	0.05-0.13	5.1-7.8	Low	0.24			
Ar	0-16	24-33	1.30-1.45	0.6-2.0	0.21-0.23	6.1-7.3	Moderate	0.28	5	6	2-4
Armiesburg	16-60	24-33	1.30-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.28			
Ay	0-9	5-12	1.35-1.50	0.6-2.0	0.18-0.20	5.6-6.5	Low	0.24	5	3	.5-2
Ayrshire	9-45	22-32	1.40-1.55	0.2-0.6	0.16-0.18	5.1-6.5	Low	0.32			
	45-55	8-20	1.45-1.60	0.2-0.6	0.12-0.14	5.1-6.5	Low	0.32			
	55-60	4-10	1.40-1.60	2.0-6.0	0.06-0.08	6.6-8.4	Low	0.20			
Bd	0-7	15-25	1.20-1.40	0.2-0.6	0.22-0.24	5.6-7.8	Low	0.43	5	6	1-3
Birds	7-60	18-27	1.40-1.60	0.2-0.6	0.20-0.22	5.1-7.8	Low	0.43			
BlB, BlD	0-30	3-10	1.60-1.80	6.0-20	0.07-0.12	5.1-6.5	Low	0.15	5	1	.5-2
Bloomfield	30-80	6-18	1.60-1.80	2.0-20	0.06-0.17	5.1-6.5	Low	0.15			
ChC	0-10	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low	0.17	5	2	.5-1
Chelsea	10-80	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-5.5	Low	0.17			
ClF	0-6	12-24	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	Low	0.32	5	5	1-3
Chetwynd	6-45	18-25	1.40-1.60	0.6-2.0	0.13-0.17	4.5-5.5	Moderate	0.32			
	45-76	18-25	1.35-1.60	0.6-2.0	0.11-0.17	4.5-6.0	Low	0.32			
	76-80	3-10	1.40-1.60	2.0-6.0	0.12-0.19	5.1-6.0	Low	0.15			
CoA	0-15	8-16	1.30-1.50	2.0-6.0	0.12-0.16	4.5-6.5	Low	0.24	3	3	.5-3
Conotton	15-52	6-20	1.25-1.60	6.0-20	0.06-0.10	4.5-7.3	Low	0.24			
	52-60	2-9	---	6.0-20	0.02-0.06	5.6-7.8	Low	0.10			
Du*.											
Dumps											
Ed	0-20	---	0.30-0.55	2.0-6.0	0.35-0.45	5.6-7.3	Low	----	---	3	55-75
Edwards Variant	20-28	---	---	0.06-0.2	0.18-0.25	7.4-8.4	Low	----			
	28-60	1-5	1.55-1.70	6.0-20	0.06-0.08	6.6-8.4	Low	----			
EkA	0-15	15-26	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5	5	.5-2
Elkinsville	15-42	22-30	1.40-1.60	0.6-2.0	0.18-0.22	4.5-6.0	Moderate	0.37			
	42-54	16-30	1.45-1.65	0.6-2.0	0.15-0.20	4.5-5.5	Moderate	0.37			
	54-60	20-34	1.40-1.60	0.6-2.0	0.17-0.21	4.5-6.0	Low	0.37			
ElA	0-19	8-18	1.35-1.55	2.0-6.0	0.12-0.15	5.6-6.0	Low	0.20	4	3	1-5
Elston	19-32	10-23	1.35-1.60	2.0-6.0	0.12-0.18	4.5-6.0	Low	0.20			
	32-43	4-10	1.45-1.65	2.0-6.0	0.08-0.13	5.6-6.0	Low	0.20			
	43-80	1-5	1.60-1.75	>20	0.05-0.07	7.4-8.4	Low	0.15			
FaB	0-18	18-27	1.40-1.55	0.6-2.0	0.09-0.18	5.6-7.3	Low	0.37	5	6	<.5
Fairpoint	18-60	18-35	1.60-1.80	0.2-0.6	0.03-0.10	5.6-7.3	Moderate	0.37			

APPENDIX B (CONTINUED)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
FbG	0-2	18-27	1.40-1.55	0.6-2.0	0.09-0.18	5.6-7.3	Low	0.37	5	6	<.5
Fairpoint	2-60	18-35	1.60-1.80	0.2-0.6	0.03-0.10	5.6-7.3	Moderate	0.37			
Ha, Hb	0-10	10-18	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5	5	1-3
Haymond	10-44	10-18	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.37			
	44-60	10-18	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.37			
Hc	0-15	6-12	1.30-1.45	2.0-6.0	0.10-0.12	6.6-7.3	Low	0.17	5	3	1-3
Haymond Variant	15-44	12-18	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low	0.37			
	44-60	6-12	1.30-1.50	0.6-2.0	0.08-0.13	6.1-7.3	Low	0.28			
HeA	0-10	12-27	1.30-1.40	0.6-2.0	0.18-0.23	5.6-6.5	Low	0.43	4	5	.5-2
Henshaw	10-49	18-34	1.30-1.50	0.2-0.6	0.15-0.19	5.1-7.3	Moderate	0.43			
	49-60	15-34	1.35-1.55	0.2-0.6	0.17-0.22	6.6-8.4	Low	0.43			
HkF	0-12	19-25	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.0	Low	0.37	5	6	1-2
Hickory	12-49	27-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Moderate	0.37			
	49-80	15-22	1.50-1.70	0.6-2.0	0.11-0.19	5.1-8.4	Low	0.37			
HoA, HoB2	0-6	10-17	1.20-1.40	0.6-2.0	0.20-0.24	4.5-6.0	Low	0.43	4	5	1-2
Hosmer	6-28	18-30	1.30-1.50	0.6-2.0	0.18-0.22	4.5-5.5	Moderate	0.43			
	28-64	18-27	1.60-1.70	<0.06	0.06-0.08	4.5-5.0	Low	0.43			
	64-80	10-18	1.30-1.50	0.2-0.6	0.06-0.08	4.5-6.0	Low	0.43			
HoC3, HoD3	0-6	10-17	1.20-1.40	0.6-2.0	0.20-0.24	4.5-6.0	Low	0.43	4	5	1-2
Hosmer	6-19	18-30	1.30-1.50	0.6-2.0	0.18-0.22	4.5-5.5	Moderate	0.43			
	19-57	18-27	1.60-1.70	<0.06	0.06-0.08	4.5-5.0	Low	0.43			
	57-60	10-18	1.30-1.50	0.2-0.6	0.06-0.08	4.5-6.0	Low	0.43			
IoA	0-10	10-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.37	5	5	1-4
Iona	10-45	18-35	1.40-1.60	0.2-0.6	0.18-0.22	5.1-7.3	Moderate	0.37			
	45-60	10-27	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.37			
IvA	0-12	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.43	4	5	1-3
Iva	12-41	22-30	1.35-1.55	0.06-0.2	0.18-0.20	5.1-6.5	Moderate	0.43			
	41-60	10-20	1.35-1.55	0.6-2.0	0.20-0.22	5.6-6.5	Low	0.43			
Kn	0-14	40-50	1.35-1.55	0.2-0.6	0.11-0.14	6.1-7.3	High	0.28	5	4	3-5
Kings	14-43	42-55	1.40-1.70	<0.06	0.09-0.12	6.1-7.3	High	0.28			
	43-60	25-45	1.40-1.70	<0.06	0.08-0.12	6.1-7.8	High	0.28			
La	0-18	5-20	1.40-1.60	2.0-6.0	0.10-0.18	6.1-8.4	Low	0.20	5	3	1-2
Landes	18-60	8-18	1.60-1.80	6.0-20	0.05-0.15	6.1-8.4	Low	0.20			
Lo	0-32	12-18	1.35-1.55	2.0-6.0	0.18-0.22	5.1-6.5	Low	0.28	5	5	2-4
Lomax	32-44	8-18	1.50-1.70	2.0-6.0	0.12-0.19	5.1-6.5	Low	0.28			
	44-60	3-12	1.70-2.00	2.0-6.0	0.05-0.11	5.1-7.3	Low	0.15			
Ly	0-17	7-20	1.40-1.60	0.6-2.0	0.14-0.18	6.1-7.8	Low	0.20	5	3	3-6
Lyles	17-37	10-27	1.50-1.70	0.6-2.0	0.12-0.19	6.1-7.8	Low	0.20			
	37-54	5-35	1.50-1.70	0.6-2.0	0.12-0.19	6.1-7.8	Low	0.20			
	54-60	0-10	1.30-1.50	2.0-6.0	0.05-0.08	6.6-7.8	Low	0.15			
MbB2	0-9	20-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.43	3	5	1-3
Markland	9-39	40-55	1.55-1.70	0.06-0.2	0.11-0.13	5.1-6.5	High	0.32			
	39-60	35-50	1.55-1.70	0.06-0.2	0.09-0.11	7.9-8.4	High	0.32			
McA	0-8	22-27	1.35-1.50	0.6-2.0	0.22-0.24	6.6-7.3	Low	0.43	3	5	1-4
McGary	8-37	35-50	1.60-1.75	<0.2	0.11-0.13	5.6-7.8	High	0.32			
	37-60	35-50	1.60-1.75	<0.2	0.14-0.16	7.9-8.4	High	0.32			

APPENDIX B (CONTINUED)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
No	0-10	12-35	1.20-1.40	0.6-2.0	0.18-0.23	5.6-8.4	Low	0.43	5	7	2-4
Nolin	10-44	18-35	1.25-1.50	0.6-2.0	0.18-0.23	5.6-8.4	Low	0.43			
	44-60	10-30	---	0.6-6.0	0.10-0.23	5.1-8.4	Low	0.43			
Pb	0-17	27-35	1.15-1.35	0.6-2.0	0.21-0.23	6.6-7.3	Moderate	0.28	5	7	3-5
Patton	17-37	27-35	1.25-1.45	0.2-2.0	0.18-0.20	6.1-7.8	Moderate	0.28			
	37-60	22-35	1.30-1.50	0.2-2.0	0.18-0.22	7.4-8.4	Moderate	0.28			
Pg	0-10	20-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Moderate	0.43	4	5	1-3
Peoga Variant	10-22	30-38	1.35-1.50	0.06-0.2	0.18-0.20	4.5-6.0	Moderate	0.43			
	22-54	40-48	1.40-1.60	0.06-0.2	0.11-0.13	4.5-6.0	High	0.43			
	54-60	28-35	1.40-1.55	0.06-0.2	0.14-0.16	5.6-6.5	Moderate	0.43			
Po	0-7	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	Moderate	0.32	4	7	2-3
Petrolia	7-60	20-35	1.40-1.60	0.2-0.6	0.18-0.20	6.1-7.8	Moderate	0.32			
PsA	0-15	18-25	1.10-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.32	5	6	3-4
Proctor	15-52	25-35	1.20-1.45	0.6-2.0	0.15-0.20	5.6-6.5	Moderate	0.43			
	52-60	15-32	1.40-1.70	0.6-6.0	0.07-0.19	6.1-7.3	Low	0.43			
Ra	0-18	18-27	1.50-1.70	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.28	5	5	4-6
Ragsdale	18-46	27-35	1.50-1.70	0.06-0.2	0.18-0.20	6.1-7.3	Moderate	0.28			
	46-60	20-27	1.50-1.70	0.06-0.2	0.20-0.22	6.6-8.4	Low	0.28			
ReA	0-13	12-20	1.20-1.45	0.6-2.0	0.17-0.24	5.6-7.3	Low	0.37	5	5	2-4
Reesville	13-41	22-35	1.30-1.55	0.2-2.0	0.17-0.22	5.1-8.4	Moderate	0.37			
	41-60	12-25	1.20-1.40	0.2-2.0	0.15-0.18	7.4-8.4	Low	0.37			
Sa	0-15	20-27	1.40-1.60	0.6-2.0	0.20-0.24	6.1-7.8	Low	0.28	5	6	4-6
Selma	15-52	18-30	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate	0.28			
	52-60	7-18	1.60-1.90	2.0-6.0	0.07-0.19	6.6-8.4	Low	0.28			
Sc	0-15	25-30	1.35-1.55	0.6-2.0	0.17-0.23	6.1-7.8	Moderate	0.28	5	6	4-6
Selma	15-52	18-30	1.40-1.60	0.6-2.0	0.15-0.19	6.1-8.4	Moderate	0.28			
	52-60	7-18	1.60-1.90	2.0-6.0	0.07-0.19	6.6-8.4	Low	0.28			
SdA	0-17	8-18	1.40-1.60	2.0-6.0	0.13-0.18	5.6-7.3	Low	0.20	2	3	1-3
Stockland	17-47	10-22	1.65-1.85	2.0-6.0	0.12-0.15	5.6-7.3	Low	0.15			
	47-80	2-8	1.80-2.00	6.0-20	0.02-0.10	6.6-8.4	Low	0.15			
SyB2, SyC3, SyD3, SyF	0-7	18-27	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.37	5	6	1-2
Sylvan	7-38	25-35	1.30-1.50	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.37			
	38-60	18-27	1.30-1.50	0.6-2.0	0.20-0.22	6.6-8.4	Moderate	0.37			
UdB*.											
Udorthents											
Vn	0-10	10-25	1.30-1.45	0.6-2.0	0.20-0.24	5.1-7.3	Low	0.43	5	5	1-3
Vincennes	10-54	20-33	1.40-1.60	0.06-0.2	0.15-0.19	4.5-5.5	Moderate	0.43			
	54-60	15-25	1.50-1.70	0.2-0.6	0.12-0.16	5.6-7.3	Low	0.43			
Vo	0-9	27-32	1.30-1.45	0.6-2.0	0.17-0.19	5.1-7.3	Moderate	0.43	5	7	1-3
Vincennes	9-55	27-35	1.40-1.60	0.06-0.2	0.14-0.17	5.1-6.0	Moderate	0.43			
	55-60	27-32	1.45-1.65	0.6-2.0	0.12-0.15	5.6-7.3	Moderate	0.43			
Wa	0-7	10-17	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5	5	1-3
Wakeland	7-60	10-17	1.30-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.37			
Wb	0-3	10-27	1.15-1.40	0.6-2.0	0.16-0.21	5.1-7.8	Low	0.32	5	---	4-12
Wallkill	3-17	15-27	1.15-1.45	0.6-2.0	0.15-0.20	5.1-7.8	Low	0.32			
	17-60	---	0.25-0.45	2.0-20	0.35-0.45	5.6-7.8	-------------	----			
Wc	0-18	12-25	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.8	Low	0.37	5	6	1-3
Wallkill	18-42	---	0.35-0.55	2.0-6.0	0.35-0.45	5.1-7.3	-------------	----			
	42-60	40-50	1.45-1.60	0.06-0.2	0.10-0.12	6.1-7.8	High	0.32			

APPENDIX B (CONTINUED)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
Zp----------------	0-5	30-45	1.40-1.55	0.2-2.0	0.12-0.21	6.1-7.3	High----------	0.28	5	4	1-3
Zipp	5-36	40-55	1.55-1.70	<0.2	0.11-0.13	6.1-7.3	High----------	0.28			
	36-60	35-50	1.55-1.70	<0.2	0.08-0.10	7.9-8.4	High----------	0.28			
Zt----------------	0-6	36-42	1.40-1.60	0.2-2.0	0.12-0.14	6.1-7.3	High----------	0.28	5	4	1-3
Zipp	6-39	40-55	1.45-1.70	<0.2	0.11-0.13	6.1-7.3	High----------	0.28			
	39-60	36-55	1.50-1.70	<0.2	0.08-0.10	6.1-7.8	High----------	0.28			

APPENDIX C

ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN KNOX COUNTY (2)

APPENDIX C. ENGINEERING INDEX PROPERTIES OF AGRICULTURAL SOILS IN KNOX COUNTY (2).

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AdB--------------	0-17	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
Ade	17-32	Fine sand--------	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
	32-65	Stratified fine sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
	65-70	Fine sand--------	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
AlA, AlB2, AlC2--	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
Alford	6-72	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	30-50	15-30
	72-80	Silt loam, silt	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
AlD3-------------	0-4	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
Alford	4-64	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	30-50	15-30
	64-70	Silt loam, silt	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
AnB, AnC, AnD----	0-16	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	80-95	30-60	<25	NP-4
Alvin	16-54	Fine sandy loam, sandy loam, sandy clay loam.	SM, SC, CL, ML	A-2, A-4, A-6	0	100	100	90-100	20-80	15-38	NP-13
	54-60	Stratified sandy loam to fine sand.	SM, SP, SP-SM	A-2, A-3	0-5	95-100	90-100	70-95	4-35	<20	NP-4
Ar---------------	0-16	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-95	35-55	20-35
Armiesburg	16-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-95	35-55	20-35
Ay---------------	0-9	Fine sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	100	100	70-85	40-60	20-30	5-15
Ayrshire	9-45	Sandy clay loam, loam, clay loam.	SC, CL	A-6	0	100	100	80-90	35-55	25-35	10-15
	45-55	Sandy loam-------	SC, SM-SC	A-4, A-6, A-2-4, A-2-6	0	100	100	60-70	30-40	15-25	5-15
	55-60	Stratified silt to loamy sand.	SM, ML, CL-ML, SM-SC	A-2-4, A-4	0	100	100	65-90	20-55	<20	NP-5
Bd---------------	0-7	Silt loam--------	CL	A-4, A-6	0	100	95-100	90-100	80-100	24-34	8-15
Birds	7-60	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	95-100	90-100	80-100	24-34	8-15
BlB, BlD---------	0-30	Loamy fine sand, loamy sand.	SM, SP, SP-SM	A-2-4, A-3, A-4	0	100	100	70-90	4-40	---	NP
Bloomfield	30-80	Fine sand, sand, sandy loam, loamy sand.	SM, SP, SP-SM	A-2-4, A-4, A-3	0	100	100	65-80	4-40	<20	NP-3
ChC--------------	0-10	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
Chelsea	10-80	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
ClF--------------	0-6	Loam-------------	CL-ML, CL	A-4, A-6	0	90-100	85-100	75-95	60-95	22-33	4-12
Chetwynd	6-45	Clay loam, sandy clay loam, loam.	SC, CL	A-4, A-6	0	90-100	85-100	70-95	40-75	20-35	8-18
	45-76	Sandy loam, loam, sandy clay loam.	SM-SC, SC, CL-ML, CL	A-2-4, A-2-6, A-4, A-6	0	70-95	65-95	60-90	30-65	20-32	5-15
	76-80	Stratified sand to sandy loam.	SW-SM, SM, SP-SM	A-2, A-1, A-3, A-4	0	70-95	65-95	35-65	6-38	---	NP

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CoA--------------- Conotton	0-15	Sandy loam--------	ML, SM	A-2, A-4	0	85-100	80-100	60-90	30-70	<30	NP-6
	15-52	Very gravelly sandy clay loam, gravelly sandy clay loam, gravelly sandy loam.	GM, SM, GM-GC, SW-SM	A-1, A-2	0-5	30-70	20-65	15-50	10-30	<25	NP-6
	52-60	Stratified very gravelly sand to very gravelly loamy sand.	GW, GM, SM, SW	A-1	0-10	25-65	15-60	10-40	0-20	---	NP
Du*. Dumps											
Ed--------------- Edwards Variant	0-20	Muck--------------	PT	A-8	0	100	90-100	80-90	10-20	---	---
	20-28	Marl--------------	CL	A-8	0	100	80-90	70-80	60-80	---	NP
	28-60	Gravelly sand-----	SP, SP-SM	A-3, A-1	0	95-100	70-95	40-70	5-25	---	NP
EkA--------------- Elkinsville	0-15	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-15
	15-42	Silty clay loam, silt loam.	CL	A-6, A-4	0	100	100	85-100	65-90	30-40	8-18
	42-54	Silty clay loam, loam, sandy clay loam.	CL	A-4, A-6	0	100	100	80-100	50-90	30-40	8-18
	54-60	Stratified silty clay loam to sandy loam.	CL, CL-ML, ML, SM	A-4, A-6	0	100	100	70-100	45-80	<30	NP-15
ElA--------------- Elston	0-19	Sandy loam--------	SM	A-2, A-4	0	100	100	60-70	30-40	<30	NP-6
	19-32	Sandy loam, loam, sandy clay loam.	SM, CL, SC, ML	A-4, A-6	0	95-100	75-95	50-80	35-65	<30	NP-15
	32-43	Loamy sand, sandy loam.	SP-SM, SM, SC, SM-SC	A-2-4, A-3, A-1-B	0-3	95-100	75-95	45-75	5-30	<25	NP-10
	43-80	Sand, fine sand	SP-SM, SM	A-3, A-2-4, A-1-B	0-3	95-100	70-95	40-70	5-25	---	NP
FaB--------------- Fairpoint	0-18	Shaly silt loam	CL, CL-ML, SC, GC	A-4, A-6, A-2	5-15	55-90	45-85	40-85	30-75	20-40	4-18
	18-60	Gravelly clay loam, very shaly silty clay loam.	GC, CL, CL-ML, SC	A-4, A-6, A-7, A-2	15-30	55-75	25-65	20-65	15-60	25-50	4-24
FbG--------------- Fairpoint	0-2	Very shaly silt loam.	CL, CL-ML, SC, GC	A-4, A-6, A-2	5-15	55-90	45-85	40-85	30-75	20-40	4-18
	2-60	Gravelly clay loam, very shaly silty clay loam.	GC, CL, CL-ML, SC	A-4, A-6, A-7, A-2	15-30	55-75	25-65	20-65	15-60	25-50	4-24
Ha, Hb------------ Haymond	0-10	Silt loam---------	ML	A-4	0	100	100	90-100	80-90	27-36	4-10
	10-44	Silt loam---------	ML	A-4	0	100	100	90-100	80-90	27-36	4-10
	44-60	Fine sandy loam, silt loam, loam.	ML, SM	A-4	0	95-100	90-100	80-100	35-90	27-36	4-10
Hc---------------- Haymond Variant	0-15	Loamy sand--------	SM	A-2, A-3	0	100	100	50-75	15-30	---	NP
	15-44	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	90-100	80-90	24-36	4-12
	44-60	Stratified fine sandy loam to loamy sand.	SM, SM-SC	A-2, A-3	0	100	100	50-80	15-30	10-20	NP-7
HeA--------------- Henshaw	0-10	Silt loam---------	ML, CL, CL-ML	A-4	0	95-100	95-100	90-100	80-100	20-35	3-10
	10-49	Silty clay loam, silt loam.	CL, ML	A-6, A-4	0	95-100	95-100	95-100	85-100	30-40	8-18
	49-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	75-100	25-40	5-15

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
HkF	0-12	Loam	CL	A-6, A-4	0-5	95-100	90-100	90-100	85-95	20-35	8-15
Hickory	12-49	Clay loam	CL	A-6, A-7	0-5	100	90-100	80-95	75-90	30-50	15-30
	49-80	Clay loam, sandy loam, loam.	CL-ML, CL	A-4, A-6	0-5	85-100	85-95	80-95	60-80	20-40	5-20
HoA, HoB2	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-35	5-15
Hosmer	6-28	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-100	35-50	15-25
	28-64	Silt loam	CL	A-6, A-7	0	100	100	90-100	80-100	30-50	10-25
	64-80	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-35	5-15
HoC3, HoD3	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-35	5-15
Hosmer	6-19	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-100	35-50	15-25
	19-57	Silt loam	CL	A-6, A-7	0	100	100	90-100	80-100	30-50	10-25
	57-60	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-35	5-15
IoA	0-10	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
Iona	10-45	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	35-50	15-30
	45-60	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	20-35	5-15
IvA	0-12	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
Iva	12-41	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	35-50	15-30
	41-60	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
Kn	0-14	Silty clay	CL, CH	A-7	0	100	100	90-100	75-95	40-60	25-40
Kings	14-43	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-70	30-45
	43-60	Stratified clay to silt loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-55	25-35
La Landes	0-18	Loamy sand	SM, SC, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<25	NP-10
	18-60	Stratified fine sand to loam.	SM, ML, SP-SM, SC	A-2, A-4	0	100	95-100	60-95	10-70	<30	NP-10
Lo	0-32	Loam	CL, CL-ML	A-4, A-6	0	100	80-95	80-95	60-75	25-35	5-15
Lomax	32-44	Fine sandy loam, loam.	SM, SC, CL, ML	A-4, A-6, A-2	0	100	80-95	80-95	30-60	20-30	3-13
	44-60	Stratified fine sandy loam to fine sand.	SP-SM, SP, SM	A-3, A-2	0-5	100	70-90	70-90	3-20	<20	NP
Ly Lyles	0-17	Fine sandy loam	SM, SM-SC	A-2-4, A-4	0	95-100	85-100	55-80	25-50	<20	NP-5
	17-37	Sandy loam, loam, fine sandy loam.	SM-SC, SC, CL-ML, CL	A-4, A-6	0	95-100	85-100	50-80	35-60	20-30	4-14
	37-54	Stratified loamy fine sand to sandy clay loam.	SM, SM-SC, SC	A-4, A-6, A-1, A-2	0	95-100	85-100	45-85	15-40	15-35	NP-15
	54-60	Fine sand, sand, sandy loam.	SP-SM, SM, SM-SC	A-2-4, A-1-B, A-3	0	95-100	85-100	45-75	5-30	<20	NP-5
MbB2	0-9	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
Markland	9-39	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-95	45-60	25-35
	39-60	Stratified clay to silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	75-95	35-60	20-35

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticit index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
McA	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	25-40	5-15
McGary	8-37	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	37-60	Stratified silty clay loam to clay.	CL, CH	A-6, A-7	0	95-100	95-100	95-100	85-100	35-55	20-35
No Nolin	0-10	Silty clay loam	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	80-100	25-40	5-18
	10-44	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	75-100	25-46	5-23
	44-60	Loam, silt loam	ML, CL, CL-ML	A-2, A-4, A-6	0-10	50-100	50-100	40-95	35-95	<30	NP-15
Pb	0-17	Silt loam	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
Patton	17-37	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	80-100	40-55	15-25
	37-60	Stratified silt loam to silty clay loam.	CL	A-6	0	100	100	95-100	75-95	25-40	10-20
Pg	0-10	Silt loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	20-30
Peoga Variant	10-22	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	20-30
	22-54	Silty clay	CL, CH	A-7	0	100	100	90-100	85-100	45-60	25-35
	54-60	Clay loam	CL	A-6, A-7	0	100	100	90-100	85-95	35-50	20-32
Po	0-7	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-100	30-45	12-20
Petrolia	7-60	Silty clay loam, silt loam.	CL	A-6, A-7, A-4	0	100	95-100	80-100	60-100	20-45	8-20
PsA	0-15	Silt loam	CL	A-6	0	100	100	95-100	85-100	25-40	10-22
Proctor	15-52	Silt loam, loam.	CL	A-7, A-6	0	95-100	90-100	85-100	65-90	25-50	10-25
	52-60	Stratified loam to sand.	SC, CL, SM-SC, CL-ML	A-2, A-4, A-6	0	85-100	80-100	50-100	25-80	20-40	5-20
Ra	0-18	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
Ragsdale	18-46	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	46-60	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
ReA	0-13	Silt loam	ML, CL-ML	A-4	0	100	90-100	90-100	85-100	24-36	4-10
Reesville	13-41	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	90-100	90-100	90-100	22-50	4-28
	41-60	Silt loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	80-90	70-90	20-40	3-18
Sa	0-15	Loam	CL	A-4, A-6	0	100	98-100	80-98	55-85	25-35	7-17
Selma	15-52	Sandy clay loam, loam, clay loam.	CL, SC	A-6	0	100	95-100	80-95	38-85	24-36	11-19
	52-60	Stratified sand to loam.	SM-SC, SC, CL-ML, CL	A-2, A-4, A-6	0	90-100	85-100	60-90	30-70	15-35	5-20
Sc	0-16	Clay loam	CL	A-6	0	100	100	85-100	60-90	25-40	11-20
Selma	16-53	Sandy clay loam, clay loam.	CL, SC	A-6	0	100	95-100	80-95	38-85	24-36	11-19
	53-60	Stratified very coarse sand to loam.	SM-SC, SC, CL-ML, CL	A-2, A-4, A-6	0	90-100	85-100	60-90	30-70	15-35	5-20
SdA Stockland	0-17	Sandy loam	SC, SM, ML, CL	A-4, A-6, A-2	0-5	95-100	95-100	60-85	30-60	15-40	NP-15
	17-47	Very gravelly sandy loam, gravelly sandy loam, gravelly sandy clay loam.	SC, SM, SM-SC	A-4, A-6, A-2	0-5	75-95	50-75	40-65	25-50	15-40	NP-15
	47-80	Stratified gravelly sand to gravelly sandy loam.	SM, SP-SM, GP-GM, GM	A-1	0-15	35-60	25-50	20-40	5-25	<20	NP-5

APPENDIX C (CONTINUED)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
SyB2, SyC3, SyD3, SyF--------------	0-7	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
Sylvan	7-38	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
	38-60	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	20-40	5-20
UdB*. Udorthents											
Vn---------------	0-10	Loam-------------	CL	A-6	0	100	85-100	75-100	60-90	25-35	10-20
Vincennes	10-54	Clay loam, sandy clay loam, loam.	CL, SC	A-6, A-7	0	100	85-100	60-100	35-80	35-45	15-25
	54-60	Stratified clay loam to sand.	SC, CL, SM, ML	A-6, A-4, A-2, A-1	0	100	85-100	40-90	15-55	15-35	NP-15
Vo---------------	0-9	Clay loam--------	CL	A-6, A-7	0	95-100	85-100	75-100	65-75	30-40	10-18
Vincennes	9-55	Clay loam, gravelly clay loam.	CL	A-6, A-7	0	95-100	75-85	60-85	55-75	35-50	15-25
	55-60	Gravelly clay loam, clay loam.	CL	A-6, A-7	0	95-100	70-85	65-85	50-70	25-35	7-15
Wa---------------	0-7	Silt loam--------	ML	A-4	0	100	100	90-100	80-90	27-36	4-10
Wakeland	7-60	Silt loam--------	ML	A-4	0	100	100	90-100	80-90	27-36	4-10
Wb---------------	0-3	Silt loam--------	ML, SM, OL	A-5, A-7	0	95-100	90-100	70-100	40-90	40-50	5-15
Wallkill	3-17	Silt loam, loam, gravelly silt loam.	CL, CL-ML, SM-SC, SC	A-4	0	75-100	70-100	60-100	40-90	15-25	5-10
	17-60	Sapric material, hemic material.	PT	A-8	0	---	---	---	---	---	---
Wc---------------	0-18	Silt loam--------	CL	A-4, A-6	0	100	95-100	90-100	80-95	24-34	8-15
Wallkill	18-42	Sapric material	PT	A-8	0	---	---	---	---	---	---
	42-60	Silty clay-------	CL, CH	A-7	0	100	95-100	90-100	85-95	40-55	20-30
Zp---------------	0-5	Silty clay-------	CL, CH	A-7, A-6	0	100	100	95-100	90-95	35-55	20-30
Zipp	5-36	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-95	45-60	25-35
	36-60	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	75-95	45-60	25-35
Zt---------------	0-6	Silty clay-------	CL, CH	A-7, A-6	0	100	100	95-100	90-95	35-55	15-30
Zipp	6-39	Silty clay-------	CL, CH	A-7	0	100	100	95-100	90-95	45-60	25-35
	39-60	Silty clay-------	CL, CH	A-7	0	100	100	90-100	75-95	45-60	25-35

APPENDIX D

STATISTICAL STREAM FLOW DATA FOR SELECTED STREAMS IN KNOX COUNTY (10)

APPENDIX D-1. STATISTICAL STREAM FLOW DATA FOR THE WABASH RIVER (10).

03345000 Wabash River at Vincennes, Ind.

LOCATION.--Lat 38°42'26", long 87°31'10", in NW¼SW¼ sec.10, T.3 N., R.10 W., Knox County, near center of span on downstream side of bridge on U.S. Highway 50 at the Indiana-Illinois State line, 4.9 miles (7.9 km) downstream from Maria Creek, 7.7 miles (12.4 km) upstream from Embarras River, and at mile 129.8 (208.8 km).

DRAINAGE AREA.--13,706 mi² (35,498 km²).

REMARKS.--Natural flow of stream affected by storage reservoirs and power development.

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
YEAR	NUMBER OF DAYS IN CLASS																																			CFS-DAYS
1930							27	44	36	29	10	7	17	10	24	10	16	21	10	14	13	21	10	6	17	4	2	2	7	5	3					5056360.0
1931				3	34	52	67	47	16	28	49	32	18	5	8	2	1	2	1	1	1															1102580.0
1932							9	23	21	29	25	22	20	18	35	24	33	23	16	10	13	18	6	3	5	7										3579050.0
1933							18	20	19	28	24	19	17	19	13	17	15	14	15	16	12	10	10	36	14	10	11	1	4	5						5817030.0
1934		9	7	13	12	17	17	34	60	48	43	36	14	6	9	10	9	8	5	5	3															1466765.0
1935					1	4	36	11	13	9	20	25	14	18	44	29	30	27	21	18	7	10	5	7	5	11										3705260.0
1936				25	18	39	22	9	14	25	39	23	24	24	16	20	7	6	13	8	5	6	10	2	2	1	2	2	4							2756030.0
1937									1	11	22	27	21	26	21	21	24	27	33	11	17	13	14	36	18	7	3	3	9							6179580.0
1938								9	20	24	16	27	16	15	31	34	28	24	7	12	19	14	10	14	15	8	5	11	8							5675600.0
1939							15	47	20	27	12	17	18	30	35	15	19	14	8	9	8	9	13	20	7	5	4	4	5	1	3					4700700.0
1940				9	6	58	79	22	15	17	18	13	21	23	29	12	7	9	8	3	6	8	9	2												1979250.0
1941			11	27	21	27	31	36	47	61	30	21	18	14	9	3	7	3	3	4																1210620.0
1942			4		1	1	1	4	8	31	40	32	38	20	35	22	26	19	7	10	8	6	7	22	14	5										3881620.0
1943								6	8	11	26	23	13	24	34	46	35	31	19	23	10	9	7	15	2	3	4	3	3	2	1	1	2	2	2	5715040.0
1944					18	7	37	79	54	20	12	7	5	8	6	6	8	11	11	14	17	17	4	3	3	2	7	8	2							3447300.0
1945					37	63	30	8	2	19	11	13	8	16	11	14	13	17	18	16	11	8	13	11	12	8	6									3779050.0
1946						3	24	6	12	13	12	13	19	28	41	25	18	11	26	22	23	12	36	14	9											4495810.0
1947					3	14	10	2	17	33	29	48	28	19	17	15	18	15	9	12	21	12	15	7	10	9	4									3963160.0
1948						2	9	27	19	31	47	21	21	17	18	13	23	17	15	15	7	13	14	8	7	8	8	5	1							4307330.0
1949							12	25	16	9	12	20	8	17	36	36	42	20	12	15	9	7	18	5	10	8	11	4	5							5207270.0
1950								5			14	28	21	14	22	27	19	17	12	11	10	29	33	15	22	11	14	14	7	9	8	3				9095590.0
1951									7	7	11	27	7	18	33	38	33	24	8	22	18	28	30	33	7	3	2	2	7							5975720.0
1952								6	21	13	15	18	24	19	18	14	18	28	22	24	13	14	28	41	16	13	3									5851120.0
1953						28	11	39	24	8	9	22	30	34	38	28	20	20	7	9	12	10	8	13	5											3151950.0
1954					6	109	39	43	21	25	22	26	10	7	20	17	6	7	2	5																1312160.0
1955					10	16	13	16	26	15	21	43	15	28	21	20	19	19	27	22	15	10	9													2970260.0
1956					7	8	8	15	8	18	25	28	13	29	27	27	27	28	30	18	8	16	12	13	3											3705710.0
1957				24	31	7	7	5	8	22	21	14	15	30	17	12	10	9	18	12	11	12	17	14	24	9	9	5	2							5073210.0
1958								1	9	5	7	9	24	37	37	39	27	23	21	28	12	13	12	12	15	10	7	8	3	3	3					6238670.0
1959					7	4	9	13	9	5	41	30	39	24	11	8	8	7	15	28	17	24	37	8	4	3	4	2	4	4						9104410.0
1960								7	18	14	21	25	28	23	29	29	41	51	35	18	9	8	8	13	5											3825430.0
1961						19	47	49	22	12	15	12	24	17	28	8	18	11	6	15	17	7	9	18	2	3	9	9								3995650.0
1962									3	21	30	28	29	21	24	35	23	18	25	31	18	14	11	28	13	5	4									4808200.0
1963						21	26	43	90	32	23	18	17	7	14	9	18	8	13	5	6	5	1	9	3	3	6									2434080.0
1964			9	17	22	78	33	22	21	13	7	17	12	14	11	14	8	11	18	10	8	8	15	5	1	2	2	3	3							2822840.0
1965					1	84	23	26	22	9	9	18	22	17	17	15	9	28	14	29	8	9	19	8	5	1										3225560.0
1966				4	9	9	29	11	23	57	39	31	18	31	20	19	12	12	13	14	8	8														2178870.0
1967					8	27	28	21	19	16	14	15	12	18	13	14	23	16	18	28	13	24	22	29	3	3	4	5								4610900.0
1968								16	11	30	21	15	3	12	14	32	36	21	28	23	19	15	19	14	7	18	13	2	5							5672610.0
1969									12	39	19	7	15	28	36	31	29	32	19	26	12	11	17	13	4	3	5	3	5	1						4904450.0
1970								3	14	18	11	28	18	36	18	36	41	33	18	15	18	27	19	9	3	2	4	3	1							4496260.0
1971								5	22	28	21	35	32	59	44	27	28	19	15	8	6	8	7	7	5	5										3319260.0
1972									3	42	37	22	20	33	27	29	32	26	17	16	10	9	7	10	7	5	8									4083170.0
1973										1	16	8	6	11	7	12	24	28	29	17	22	46	50	34	24	26	4									7785900.0

CLASS	CFS	TOTAL	ACCUM	PERC7	CLASS	CFS	TOTAL	ACCUM	PERC7	CLASS	CFS	TOTAL	ACCUM	PERC7	CLASS	CFS	TOTAL	ACCUM	PERC7
0	0.00	0	16071	100.0	9	2900.00	935	12651	78.7	18	13000.0	677	4469	27.8	27	57000	99	242	1.5
1	770.00	9	16071	100.0	10	3400.00	960	11716	72.9	19	15000.0	664	3792	23.6	28	67000	85	143	.8
2	910.00	31	16062	99.9	11	4000.00	968	10756	66.9	20	14000.0	502	3128	19.5	29	80000	30	58	.3
3	1100.00	122	16031	99.8	12	4800.00	788	9788	60.9	21	21000.0	544	2626	16.3	30	94000	18	28	.1
4	1300.00	252	15909	99.0	13	5600.00	920	9000	56.0	22	25000.0	589	2082	13.0	31	110000	4	10	
5	1500.00	661	15657	97.4	14	6600.00	1008	8080	50.3	23	29000.0	539	1493	9.3	32	130000	2	6	
6	1800.00	709	14996	93.3	15	7600.00	914	7072	44.0	24	35000.0	336	954	5.9	33	150000	2	4	
7	2100.00	805	14287	88.9	16	9200.00	884	6158	38.3	25	41000.0	213	618	3.8	34	180000	2	2	
8	2500.00	831	13482	83.9	17	11000.00	805	5274	32.8	26	48000.0	163	405	2.5					

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1		3		7		14		30		60		90		120		183		ANNUAL	
1931	1200.00	7	1300.00	8	1380.00	9	1450.00	9	1510.00	4	1650.00	9	1680.00	7	1720.00	5	1870.00	2	3900.00	1
1932	1630.00	18	1660.00	18	1740.00	19	2130.00	25	2370.00	26	2830.00	26	3000.00	23	3150.00	20	3850.00	28	9070.00	16
1933	1850.00	23	1890.00	24	2010.00	25	2120.00	24	2950.00	33	3320.00	31	3500.00	28	3680.00	27	4100.00	23	10000.00	19
1934	1850.00	24	1850.00	23	1900.00	23	1970.00	20	2100.00	20	2670.00	24	2960.00	22	2920.00	19	3490.00	17	10700.00	24
1935	770.00	1	783.00	1	799.00	1	887.00	1	1300.00	5	1370.00	2	1630.00	5	2240.00	11	2630.00	9	6350.00	5
1936	1420.00	12	1530.00	16	1630.00	16	1640.00	15	1690.00	12	1950.00	14	2750.00	19	3250.00	21	3710.00	19	10500.00	22
1937	1130.00	5	1130.00	5	1140.00	5	1180.00	5	1220.00	2	1430.00	4	1800.00	10	2270.00	13	4610.00	26	12700.00	29
1938	2270.00	32	2270.00	31	2430.00	31	2570.00	33	2810.00	30	3970.00	37	3850.00	31	4270.00	30	6000.00	32	13200.00	31
1939	2110.00	28	2110.00	27	2160.00	27	2240.00	27	2360.00	25	2670.00	25	3030.00	25	3360.00	24	4800.00	27	16500.00	37
1940	1670.00	19	1670.00	19	1670.00	14	1670.00	16	1760.00	15	1870.00	12	1980.00	12	1950.00	8	2500.00	7	7720.00	9

APPENDIX D-1 (CONTINUED)

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1941	1080.00 4	1090.00 4	1100.00 4	1160.00 4	1340.00 6	1480.00 8	1550.00 3	1640.00 3	2020.00 5	4780.00 2
1942	960.00 2	970.00 2	986.00 2	1000.00 2	1230.00 3	1400.00 3	1690.00 8	2250.00 12	3390.00 16	7730.00 10
1943	2390.00 35	2390.00 33	2440.00 32	2560.00 32	3020.00 34	3300.00 29	3800.00 30	4600.00 31	6130.00 33	10400.00 20
1944	1910.00 25	1920.00 25	1990.00 24	2070.00 23	2200.00 23	2310.00 19	2430.00 17	2700.00 18	3110.00 13	12800.00 30
1945	1300.00 9	1320.00 9	1360.00 8	1420.00 8	1490.00 7	1560.00 7	1630.00 4	1630.00 2	1680.00 1	9230.00 18
1946	2600.00 37	2630.00 37	2800.00 37	3040.00 39	3450.00 38	4800.00 41	5640.00 40	7670.00 41	7660.00 37	15400.00 35
1947	1450.00 15	1470.00 13	1520.00 14	1560.00 12	1690.00 13	1870.00 13	2270.00 15	2580.00 16	3370.00 15	8010.00 11
1948	2040.00 26	2050.00 26	2080.00 26	2100.00 28	2640.00 29	2940.00 27	3240.00 28	3340.00 23	4020.00 21	12600.00 28
1949	1740.00 20	1780.00 20	1890.00 21	2050.00 22	2170.00 21	2460.00 21	2760.00 20	3730.00 29	5120.00 29	18000.00 38
1950	2100.00 27	2130.00 28	2200.00 28	2360.00 29	2910.00 32	3550.00 34	4870.00 37	5020.00 37	6760.00 35	20500.00 43
1951	3600.00 43	3730.00 43	4000.00 43	4350.00 43	4770.00 43	7980.00 43	8990.00 43	8720.00 43	10500.00 41	18900.00 41
1952	2360.00 34	2390.00 34	2470.00 34	2530.00 31	2630.00 28	3530.00 33	4160.00 34	5530.00 36	7980.00 38	15300.00 34
1953	2250.00 31	2250.00 29	2250.00 29	2300.00 28	2340.00 24	2530.00 23	3010.00 24	3380.00 25	4060.00 22	11400.00 25
1954	1430.00 13	1440.00 12	1510.00 12	1620.00 14	1650.00 11	1670.00 10	1700.00 9	1700.00 4	1930.00 4	5360.00 4
1955	1460.00 14	1500.00 14	1550.00 15	1680.00 17	1800.00 16	2030.00 16	2140.00 13	2530.00 15	3170.00 14	6810.00 6
1956	1400.00 11	1400.00 11	1410.00 10	1500.00 10	1760.00 14	2420.00 20	3870.00 32	4750.00 32	5810.00 31	9190.00 17
1957	1140.00 6	1160.00 6	1180.00 6	1190.00 6	1240.00 4	1310.00 1	1460.00 1	1830.00 7	2640.00 10	7100.00 7
1958	2430.00 36	2550.00 36	2640.00 36	2790.00 36	3780.00 41	3890.00 35	4970.00 38	6300.00 38	12700.00 43	18400.00 39
1959	3400.00 42	3400.00 42	3400.00 42	3470.00 42	3690.00 40	4740.00 40	6420.00 41	7010.00 39	10600.00 42	18700.00 40
1960	1390.00 10	1390.00 10	1430.00 11	1810.00 13	2010.00 18	2470.00 22	2960.00 21	3270.00 22	4450.00 25	10400.00 21
1961	1610.00 17	1630.00 17	1660.00 17	1880.00 18	1940.00 17	1980.00 15	2170.00 14	2200.00 10	2510.00 8	8670.00 13
1962	2800.00 39	2940.00 41	3280.00 41	3330.00 41	3630.00 39	3890.00 36	4230.00 35	5230.00 34	6260.00 34	15600.00 36
1963	1800.00 21	1800.00 21	1800.00 20	1830.00 19	2090.00 19	2270.00 17	2360.00 18	2580.00 14	2870.00 11	8980.00 14
1964	1000.00 3	1000.00 3	1000.00 3	1040.00 3	1180.00 1	1450.00 5	1490.00 2	1500.00 1	1920.00 3	5100.00 3
1965	1480.00 16	1510.00 15	1520.00 13	1530.00 11	1540.00 9	1620.00 8	1680.00 6	1740.00 8	2230.00 6	9040.00 15
1966	2240.00 30	2310.00 32	2410.00 30	2500.00 30	2530.00 27	3170.00 28	3430.00 27	3690.00 28	4150.00 24	8310.00 12
1967	1240.00 8	1240.00 7	1330.00 7	1400.00 7	1580.00 10	1660.00 11	1830.00 11	1990.00 9	3050.00 12	10700.00 23
1968	1840.00 22	1840.00 22	1900.00 22	2010.00 21	2170.00 22	2270.00 18	2450.00 10	2650.00 17	3650.00 18	13600.00 32
1969	2800.00 40	2890.00 40	2910.00 39	3000.00 38	3240.00 36	3510.00 32	4100.00 33	4940.00 33	7240.00 36	14200.00 33
1970	2800.00 41	2820.00 39	2870.00 38	2930.00 37	3300.00 37	5060.00 42	6460.00 42	8230.00 42	9230.00 39	12200.00 26
1971	2340.00 33	2400.00 35	2480.00 35	2590.00 34	3030.00 35	4370.00 38	4690.00 36	5260.00 35	5690.00 30	12600.00 27
1972	2200.00 29	2270.00 30	2480.00 33	2630.00 35	2840.00 31	3320.00 30	3630.00 29	3540.00 26	4840.00 28	7610.00 8
1973	2700.00 38	2770.00 38	2980.00 40	3270.00 40	3800.00 42	4860.00 39	5670.00 39	7180.00 40	10500.00 40	19700.00 42

HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL
1930	97200.0 5	95300.0 5	89700.0 4	81400.0 3	61200.0 3	44200.0 3	37600.0 3	31300.0 3	24200.0 9	13900.0 13
1931	18000.0 42	16700.0 43	12900.0 44	8350.0 44	6050.0 44	4660.0 44	4270.0 44	4050.0 44	3990.0 44	3020.0 44
1932	47000.0 29	46300.0 29	44900.0 30	40200.0 29	30600.0 30	24300.0 28	21400.0 27	18500.0 27	15200.0 29	9780.0 30
1933	90000.0 7	88400.0 7	83300.0 6	69400.0 5	51300.0 6	42700.0 5	37700.0 2	31300.0 4	27600.0 3	15900.0 7
1934	19000.0 41	18700.0 41	17000.0 41	14500.0 41	11700.0 41	8290.0 41	6510.0 42	5730.0 42	4720.0 42	4820.0 41
1935	46500.0 31	46300.0 30	45600.0 29	43000.0 25	32300.0 27	22100.0 34	20400.0 31	18100.0 29	15700.0 28	10200.0 28
1936	78200.0 10	78200.0 10	68800.0 13	51000.0 17	33700.0 25	23400.0 29	20400.0 32	16600.0 33	12400.0 36	7530.0 37
1937	76400.0 12	75900.0 11	74000.0 10	66000.0 7	51400.0 5	38700.0 8	30100.0 11	30300.0 5	25400.0 4	16900.0 4
1938	73700.0 13	73500.0 13	72100.0 11	67100.0 6	55900.0 4	42500.0 6	33200.0 8	28600.0 10	24900.0 6	15500.0 10
1939	101000.0 3	98600.0 3	84800.0 5	62000.0 10	47400.0 11	38400.0 9	34300.0 6	28500.0 11	22000.0 14	12900.0 18
1940	29700.0 38	29200.0 38	27100.0 39	22100.0 39	20200.0 39	14000.0 39	12300.0 39	11500.0 39	8970.0 40	5410.0 40
1941	15600.0 44	14800.0 44	14600.0 43	11700.0 43	8360.0 43	8110.0 43	6160.0 43	5500.0 43	4650.0 43	3320.0 43
1942	46600.0 30	46200.0 31	43300.0 31	37900.0 32	26600.0 34	26000.0 26	24300.0 23	20300.0 25	16500.0 25	10600.0 25
1943	184000.0 1	179000.0 1	156000.0 1	115000.0 1	77900.0 2	45900.0 2	35800.0 4	29900.0 8	24300.0 7	15700.0 8
1944	69700.0 16	68200.0 16	63900.0 16	59800.0 13	46500.0 13	33400.0 16	27300.0 18	23400.0 21	18400.0 26	9420.0 31
1945	51100.0 27	50800.0 27	48400.0 25	42300.0 27	31000.0 29	27100.0 24	25600.0 22	24000.0 19	18400.0 21	10400.0 27
1946	37600.0 34	37100.0 34	36100.0 34	32500.0 34	24100.0 36	21600.0 35	20900.0 38	18000.0 31	18100.0 22	12300.0 20
1947	52500.0 25	51700.0 25	47700.0 27	40200.0 30	31600.0 28	30700.0 21	26400.0 20	22000.0 23	17900.0 23	10900.0 23
1948	69000.0 17	67400.0 17	63500.0 17	53500.0 18	48600.0 8	34600.0 13	29200.0 16	24500.0 17	19200.0 19	11800.0 21
1949	71000.0 15	70000.0 14	68200.0 14	60700.0 12	50900.0 7	43200.0 4	34500.0 5	29500.0 8	23000.0 12	14300.0 11
1950	120000.0 2	116000.0 2	110000.0 2	101000.0 2	83400.0 1	68600.0 1	55600.0 1	52200.0 1	40000.0 1	24900.0 1
1951	79400.0 9	78600.0 9	74400.0 8	61700.0 11	44200.0 15	33500.0 15	29400.0 15	27400.0 13	24300.0 8	16400.0 5
1952	50600.0 28	49800.0 28	47000.0 28	41500.0 28	34700.0 24	30900.0 19	29700.0 12	28500.0 12	25400.0 5	16000.0 6
1953	36900.0 37	36600.0 36	35400.0 35	31400.0 35	28700.0 32	22500.0 33	18800.0 33	16200.0 34	13600.0 34	8640.0 34
1954	17500.0 43	17000.0 42	15600.0 42	12700.0 42	10500.0 42	8150.0 42	7430.0 41	6620.0 41	5340.0 41	3590.0 42
1955	28200.0 39	28100.0 39	27900.0 38	24600.0 38	20500.0 38	16800.0 38	14500.0 38	13700.0 38	12100.0 37	8140.0 35
1956	37400.0 36	36800.0 35	34700.0 36	30200.0 36	25800.0 35	19800.0 36	16700.0 36	16900.0 32	14300.0 32	10100.0 29
1957	68600.0 18	67000.0 18	61300.0 18	50100.0 19	43200.0 16	35300.0 12	32900.0 9	31900.0 2	24100.0 10	13900.0 14
1958	99600.0 4	97600.0 4	90000.0 3	72600.0 4	48300.0 9	41600.0 7	33200.0 7	26000.0 14	20900.0 16	17100.0 3
1959	92100.0 6	88600.0 6	80700.0 7	63200.0 8	45400.0 14	35600.0 11	31900.0 10	29800.0 7	22700.0 13	14000.0 12
1960	37500.0 35	35900.0 37	32700.0 37	26600.0 37	20800.0 37	16000.0 37	16200.0 37	15400.0 35	14800.0 30	10500.0 26
1961	64300.0 20	63300.0 20	59800.0 20	57400.0 15	47800.0 10	34300.0 14	29400.0 13	25100.0 16	19200.0 20	10900.0 24
1962	52900.0 24	52000.0 24	49400.0 24	42900.0 26	35500.0 22	30700.0 20	27000.0 19	23500.0 20	19400.0 18	13200.0 16
1963	56000.0 22	55000.0 22	52100.0 22	44000.0 24	32900.0 26	22600.0 32	17500.0 34	14400.0 37	10800.0 38	6670.0 38
1964	71100.0 14	69800.0 15	64400.0 15	50100.0 20	35900.0 21	27800.0 23	21500.0 26	18100.0 30	13600.0 33	7710.0 36
1965	41200.0 33	40700.0 33	38700.0 33	33700.0 33	28500.0 33	23000.0 31	21100.0 28	18700.0 26	14800.0 31	8840.0 33
1966	23800.0 40	23100.0 40	22300.0 40	18200.0 40	16500.0 40	12000.0 40	10500.0 40	9960.0 40	9040.0 39	5960.0 39
1967	62200.0 21	61600.0 21	59000.0 21	50500.0 18	35000.0 23	24600.0 27	22300.0 25	22700.0 22	21500.0 15	12600.0 19
1968	76700.0 11	75700.0 12	70600.0 12	58900.0 14	40800.0 18	33200.0 17	28600.0 17	25300.0 15	23500.0 11	15500.0 9
1969	80900.0 8	79700.0 8	74200.0 9	63100.0 9	47100.0 12	31000.0 18	26100.0 21	24200.0 18	20200.0 17	13400.0 15
1970	67100.0 19	65600.0 19	60500.0 19	49300.0 21	37300.0 19	28000.0 22	23500.0 24	21300.0 24	17300.0 24	12900.0 17
1971	45400.0 32	44900.0 32	43000.0 32	38200.0 31	30200.0 31	23200.0 30	17400.0 35	15300.0 36	12000.0 35	9080.0 32
1972	53700.0 23	53100.0 23	50700.0 23	45400.0 22	37200.0 20	26000.0 25	21100.0 29	18200.0 28	16400.0 27	11200.0 22
1973	51800.0 26	51000.0 26	48300.0 26	45000.0 23	41600.0 17	36700.0 10	29400.0 14	29300.0 9	29300.0 2	21300.0 2

APPENDIX D-1 (CONTINUED)

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               STATISTICS ON NORMAL MONTHLY MEANS(ALL DAYS)

    OCT          NOV          DEC          JAN          FEB          MARCH        APRIL        MAY          JUNE         JULY         AUG          SEPT

               BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.4307E+04 0.6228E+04 0.8867E+04 0.1503E+05 0.1667E+05 0.1898E+05 0.2104E+05 0.1774E+05 0.1217E+05 0.8655E+04 0.5029E+04 0.3687E+04
0.1108E+08 0.3061E+08 0.6668E+08 0.2732E+09 0.1795E+09 0.9802E+08 0.1295E+09 0.1505E+09 0.5790E+08 0.4987E+08 0.1526E+08 0.5340E+07
0.3329E+04 0.5533E+04 0.8166E+04 0.1653E+05 0.1340E+05 0.9901E+04 0.1138E+05 0.1227E+05 0.7609E+04 0.7062E+04 0.3906E+04 0.2311E+04
0.2037E+01 0.2489E+01 0.1649E+01 0.2211E+01 0.1144E+01 0.3504E+00 0.3538E+00 0.2084E+01 0.1713E+01 0.2341E+01 0.3108E+01 0.2970E+01
0.7729E+00 0.8884E+00 0.9209E+00 0.1100E+01 0.8038E+00 0.5217E+00 0.5410E+00 0.6916E+00 0.6250E+00 0.8159E+00 0.7768E+00 0.6268E+00
0.3112E+01 0.4500E+01 0.6407E+01 0.1086E+02 0.1204E+02 0.1371E+02 0.1520E+02 0.1282E+02 0.8797E+01 0.6254E+01 0.3634E+01 0.2664E+01


              STATISTICS ON NORMAL ANNUAL MEANS(ALL DAYS)

      MEAN             VARIANCE         STANDARD DEVIATION        SKEWNESS          COEFF. OF VARIATION       SERIAL CORR
   0.1150E+05         0.2123E+08            0.4608E+04           0.3600E+00             0.4006E+00           0.2754E+00


               STATISTICS ON LOG MONTHLY MEANS(ALL DAYS)

    OCT          NOV          DEC          JAN          FEB          MARCH        APRIL        MAY          JUNE         JULY         AUG          SEPT

               BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.3540E+01 0.3671E+01 0.3790E+01 0.3959E+01 0.4068E+01 0.4205E+01 0.4254E+01 0.4162E+01 0.4007E+01 0.3831E+01 0.3618E+01 0.3509E+01
0.7621E-01 0.1032E+00 0.1407E+00 0.2013E+00 0.1555E+00 0.7784E-01 0.6617E-01 0.7997E-01 0.7574E-01 0.9205E-01 0.6697E-01 0.4697E-01
0.2761E+00 0.3212E+00 0.3751E+00 0.4486E+00 0.3944E+00 0.2790E+00 0.2572E+00 0.2828E+00 0.2752E+00 0.3035E+00 0.2588E+00 0.2167E+00
0.5837E+00 0.3095E+00 0.1881E+00 0.8127E-01-0.2679E+00-0.8389E+00-0.2669E+00-0.2263E+00-0.4935E+00 0.1116E+00 0.4708E+00 0.5653E+00
0.7798E-01 0.8751E-01 0.9899E-01 0.1133E+00 0.9695E-01 0.6635E-01 0.6047E-01 0.6794E-01 0.6868E-01 0.7922E-01 0.7152E-01 0.6177E-01
0.7594E+01 0.7875E+01 0.8130E+01 0.8494E+01 0.8727E+01 0.9021E+01 0.9126E+01 0.8929E+01 0.8596E+01 0.8218E+01 0.7762E+01 0.7527E+01


               STATISTICS ON LOG ANNUAL MEANS(ALL DAYS)

      MEAN             VARIANCE         STANDARD DEVIATION        SKEWNESS          COEFF. OF VARIATION       SERIAL CORR
   0.4020E+01         0.4223E-01            0.2055E+00          -0.1002E+01             0.5112E-01           0.2040E+00

     ANNUAL PEAKS

             1913     255000                       1944      70400
             1914      38800                       1945      51100
             1915      25300                       1946      37600
             1916      67200                       1947      53000
             1917      41600                       1948      71500
             1918      47900                       1949      71000
             1919      63000                       1950     120000
             1920      60200                       1951      79400
             1921      40400                       1952      51200
             1922      79600                       1953      37200
             1923      53500                       1954      10000
             1924      52500                       1955      20200
             1925      58000                       1956      37400
             1926      54500                       1957      69400
             1927      74000                       1958      99600
             1928      55500                       1959      97000
             1929      81400                       1960      38000
             1930      97200                       1961      64800
             1931      18000                       1962      53000
             1932      47000                       1963      56300
             1933      91600                       1964      71900
             1934      19000                       1965      41500
             1935      46500                       1966      24200
             1936      78400                       1967      62300
             1937      76500                       1968      77200
             1938      73700                       1969      81000
             1939     102000                       1970      47700
             1940      29900                       1971      45500
             1941      16200                       1972      54000
             1942      47100                       1973      52000
             1943     149000
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APPENDIX D-2. STATISTICAL STREAM FLOW DATA FOR THE WHITE RIVER (10).

03374000 White River at Petersburg, Ind.

LOCATION.--Lat 38°30'39", long 87°17'22", in SW¼SW¼ sec.15, T.1 N., R.8 W., Pike County, on left bank 300 ft (91 m) downstream from bridge on State Highway 61, 0.4 mile (0.6 km) upstream from Prides Creek, 1.4 mile (2.3 km) north of Petersburg, and at mile 47.7 (76.7 km).

DRAINAGE AREA.--11,125 mi^2 (28,814 km^2).

REMARKS.--Natural flow of stream affected by reservoirs.

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

NUMBER OF DAYS IN CLASS

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
YEAR																																				CFS_DAYS
1929						1	5	13	16	16	21	19	18	22	16	22	18	13	17	22	21	19	16	17	11	12	10	15	8							5876760.0
1930			1	22	20	13	26	18	11	21	17	12	19	13	10	16	17	11	16	13	10	12	9	11	10	12	1	3	2	3	4	2	2			4570720.0
1931		1	2	45	66	35	24	19	31	14	22	21	13	12	10	12	8	13	5	6	4															1143590.0
1932								2	19	25	40	21	22	13	20	20	22	32	23	20	14	13	16	16	8	4	2	3	5	6						4682050.0
1933						5	19	13	6	17	21	13	13	11	7	13	19	19	15	19	22	15	13	18	17	20	13	15	18	7	3	2				7525850.0
1934					4	21	40	64	36	25	43	21	26	19	17	10	11	6	7	2	2	2	3													1337830.0
1935				1	27	24	15	17	23	23	33	16	15	25	10	6	19	18	15	15	11	12	5	10	8	11	4									3154250.0
1936		1	29	19	32	20	22	25	15	27	28	12	12	16	11	12	20	11	9	7	3	5	8	13	7											2171465.0
1937					3	3	2		18	20	42	19	15	30	24	21	20	23	9	16	10	16	15	17	9	5	4	3	2	3	2	3	2	6	2	6364124.0
1938								1	5	15	31	12	38	32	23	19	19	19	15	22	21	12	13	19	12	11	9	9	6							5344900.0
1939						40	13	16	21	10	22	15	11	31	30	21	18	8	12	18	7	7	10	11	10	7	13	4	8	3	3					4687150.0
1940			13	8	59	42	9	7	11	9	34	11	8	12	20	20	10	2	10	14	10		1	3	1	2	2	2	4	2						2220316.0
1941		28	34	21	39	33	33	52	36	16	23	9	7	5	4	4	1	2	1	1	3	3														780501.0
1942		3	2	1	1	7	4	14	16	22	40	26	34	14	15	13	17	23	15	28	9	6	13	16	18	2	2	4								3692445.0
1943					19	21	7	16	12	7	17	16	22	28	32	25	22	17	15	23	11	16	4	2	4	4	4	5	8	4	4					4433620.0
1944					39	64	53	34	22	11	15	9	6	1	5	8	8	13	9	19	7	8	3	7	3	4	5	1	2	3	2					2819640.0
1945			9	22	22	23	4	15	20	14	6	16	22	9	17	7	10	12	16	12	11	4	10	17	11	9	5	11	5	5	5					5023811.0
1946					6	13	3	6	5	10	11	15	29	32	26	32	20	11	12	26	30	16	18	18	16	8	2									4390780.0
1947			2	8	18	5		4	19	6	24	15	27	29	23	16	18	17	21	16	11	5	15	23	14	11	8	14								4072082.0
1948							4	64	41	15	33	40	18	11	5	4	15	17	20	12	11	12	13	3	3	4	1	8	5	2						3498250.0
1949					9	9	7	9	4	22	24	27	22	12	15	20	22	13	20	24	19	5	6	21	4	7	9	12	5	7	10	1				6352580.0
1950								13	7	26	30	15	14	15	10	18	18	18	12	33	25	23	11	3	5	3	7	9	18	11	5	10	4			8307300.0
1951						5	5	13	14	8	22	13	15	21	27	13	19	14	21	16	19	13	19	27	21	7	10	15	6							4803900.0
1952					8	16	14	16	22	16	16	8	6	17	17	11	13	18	12	22	17	20	11	22	24	12	8	11	4	1						5623700.0
1953				2	24	38	14	16	10	6	34	24	13	20	16	18	16	14	27	22	12	8	8	11	3	2										2719236.0
1954		5	22	95	51	22	4	8	13	24	29	18	10	18	7	15	11	9	4																	955614.0
1955		2	9	6	41	31	17	15	2	10	19	11	14	16	22	23	22	18	15	9	13	7	8	12	10	6	1									2925820.0
1956							4	7	10	13	46	18	21	16	27	22	24	25	25	16	11	13	20	23	14	9	3	3								4544960.0
1957					36	9	11	8	4	20	21	16	19	13	9	25	20	20	14	23	16	13	23	10	6	5	4	7	8	5						4855190.0
1958									15	12	6	5	9	15	27	33	28	20	27	34	19	18	21	17	17	10	6	7	5	3	1					6021570.0
1959							12	1	14	18	43	21	18	26	21	13	13	21	34	25	25	13	13	13	4	4	3	4	5	2	2					4506300.0
1960							1	20	45	15	30	13	15	17	36	36	24	27	15	26	21	9	12	5	6	5	1	4								3581340.0
1961						1	54	64	45	11	52	11	10	13	13	5	4	12	12	14	8	6	8	15	5	9	7	11	1	2	2	3	2			4407100.0
1962							19	19	5	14	26	28	33	22	32	24	29	14	16	14	8	12	7	16	15	2	8	4								3805600.0
1963					2	11	9	11	63	77	49	17	13	12	17	10	5	12	7	13	2	1	1	8	3	4	3	10	2	3						3003570.0
1964		1	20	40	53	24	14	23	26	7	14	22	6	12	5	7	7	5	8	11	10	7	4	5	6	3	3	4	5	4	4					3262880.0
1965			1	41	21	7	13	20	25	11	23	12	23	29	27	10	12	19	12	10	5	4	8	11	14	4	3									2835440.0
1966						3	20	36	68	34	48	17	17	10	13	11	15	13	9	15	12	3	4	13												2188220.0
1967					10	38	14	15	16	20	21	10	5	[illegible]	10	13	17	12	21	26	18	11	19	19	10	6	2	5								4041700.0
1968					9	7	4	21	21	13	15	10	9	33	19	12	18	24	28	23	26	10	15	18	6	6	5	7	2	2	3					4418540.0
1969								24	23	4	11	13	14	17	36	23	24	32	25	33	17	9	7	14	11	11	5	2	2	3	3					4898900.0
1970							3	18	14	15	31	19	26	21	23	21	20	18	23	23	19	14	22	20	4	2	5									3917600.0
1971							4	7	27	35	45	24	27	24	32	19	23	24	10	14	5	4	22	3	4	2	4	4	2							3222520.0
1972							19	40	18	26	20	23	5	30	12	20	33	18	15	23	24	9	4	8	2	1	2	8	6							3709010.0
1973										13	26	10	6	7	6	14	22	33	28	29	36	22	32	27	19	15	7	11								6494700.0

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	.00	0	16436	100.0	9	2300.00	796	12381	75.3	18	11000.0	702	4982	30.3	27	53000	235	542	3.3
1	573.00	41	16436	100.0	10	2700.00	1204	11585	70.5	19	13000.0	811	4280	26.0	28	63000	134	307	1.8
2	[illegible]	144	16395	99.8	11	3300.00	749	10381	63.2	20	16000.0	617	3469	21.1	29	75000	81	173	1.0
3	[illegible]	345	16251	98.9	12	3900.00	747	9632	58.6	21	19000.0	434	2852	17.4	30	90000	53	92	.5
4	[illegible]	684	15906	96.8	13	4600.00	824	8885	54.1	22	22000.0	490	2418	14.7	31	110000	21	39	.2
5	[illegible]	571	15222	92.6	14	5500.00	814	8061	49.0	23	26000.0	564	1928	11.7	32	130000	10	18	.1
6	[illegible]	556	14651	89.1	15	6600.00	741	7247	44.1	24	32000.0	373	1364	8.3	33	150000	6	8	.0
7	[illegible]	852	14095	85.8	16	7800.00	774	6506	39.6	25	38000.0	262	991	6.0	34	180000	2	2	.0
8	[illegible]	862	13243	80.6	17	9300.00	750	5732	34.5	26	45000.0	187	729	4.4					

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1		3		7		14		30		60		90		120		183		ANNUAL	
1929	1220.00	24	1300.00	26	1420.00	27	1460.00	27	1710.00	30	2470.00	36	2950.00	36	3720.00	36	5160.00	35	12900.00	38
1930	[illegible]	28	1440.00	29	1460.00	29	1400.00	28	1630.00	29	2140.00	31	2640.00	34	3520.00	13	6570.00	40	19000.00	43
1931	[illegible]	3	758.00	7	941.00	9	860.00	9	882.00	9	916.00	6	987.00	3	1020.00	4	1060.00	1	2730.00	1
1932	[illegible]	13	1070.00	17	1110.00	17	1150.00	19	1440.00	24	2690.00	38	2560.00	33	2760.00	30	3430.00	26	11800.00	28
1933	1740.00	15	1820.00	39	2010.00	41	2290.00	41	3160.00	42	4370.00	44	5290.00	43	3540.00	42	3990.00	39	14800.00	33
1934	[illegible]	26	1300.00	25	1300.00	25	1400.00	25	1450.00	25	1710.00	24	1910.00	20	1840.00	17	2350.00	16	10800.00	23
1935	[illegible]	14	970.00	12	[illegible]	12	1040.00	12	1090.00	13	1260.00	13	1550.00	13	1730.00	15	2180.00	12	4740.00	3
1936	[illegible]	12	940.00	12	959.00	13	1130.00	18	1350.00	22	1610.00	22	2170.00	27	2330.00	23	2920.00	18	9210.00	19
1937	600.00	5	683.00	5	642.00	5	727.00	5	810.00	3	863.00	2	1010.00	6	1170.00	8	2340.00	15	15200.00	39
1938	[illegible]	42	2360.00	42	2530.00	43	2740.00	43	3510.00	45	4260.00	42	4420.00	41	4380.00	40	5170.00	36	12600.00	29
1939	[illegible]	25	1250.00	24	1270.00	24	1290.00	24	1330.00	20	1940.00	21	2070.00	25	2350.00	24	3940.00	29	13900.00	32
1940	[illegible]	11	953.00	11	[illegible]	11	955.00	11	1010.00	10	1070.00	10	1110.00	9	1160.00	7	1830.00	9	7620.00	18

APPENDIX D-2 (CONTINUED)

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1		3		7		14		30		60		90		120		183		ANNUAL	
1941	574.00	2	585.00	2	600.00	2	616.00	1	650.00	1	710.00	1	812.00	1	909.00	1	1120.00	2	4940.00	4
1942	573.00	1	586.00	1	598.00	1	640.00	2	878.00	8	964.00	7	1120.00	10	1280.00	9	2090.00	11	6370.00	5
1943	1080.00	18	1090.00	18	1110.00	18	1130.00	17	1180.00	15	1440.00	17	1910.00	21	2280.00	22	4250.00	31	10900.00	24
1944	1000.00	16	1020.00	15	1040.00	15	1070.00	14	1110.00	14	1320.00	14	1310.00	11	1470.00	11	1640.00	8	8720.00	18
1945	741.00	7	755.00	6	764.00	6	797.00	6	856.00	6	1050.00	9	1100.00	8	1300.00	10	1450.00	6	11300.00	26
1946	1690.00	37	1730.00	37	1810.00	37	1980.00	38	2120.00	37	3430.00	40	5090.00	42	6850.00	44	8300.00	43	15900.00	39
1947	756.00	8	803.00	9	895.00	10	954.00	10	1090.00	11	1210.00	11	1530.00	12	2020.00	19	3020.00	22	8150.00	11
1948	1580.00	34	1600.00	34	1640.00	34	1700.00	35	1810.00	33	1810.00	25	1920.00	22	2260.00	21	3510.00	28	13100.00	31
1949	1100.00	19	1110.00	19	1130.00	19	1190.00	22	1380.00	23	1630.00	23	1940.00	23	3530.00	34	4300.00	32	19400.00	44
1950	1790.00	38	1780.00	38	1790.00	36	1860.00	36	2170.00	39	2960.00	39	3380.00	39	3640.00	35	4480.00	33	19700.00	45
1951	2400.00	43	2480.00	43	2510.00	42	2660.00	42	2870.00	41	4290.00	43	5490.00	44	5200.00	41	7430.00	42	18500.00	42
1952	1120.00	21	1120.00	21	1130.00	20	1180.00	20	1270.00	19	1520.00	18	1890.00	19	2640.00	28	4240.00	30	15500.00	36
1953	1140.00	22	1160.00	22	1170.00	22	1190.00	21	1210.00	17	1340.00	15	1620.00	18	1730.00	18	2270.00	13	8310.00	13
1954	777.00	9	784.00	8	799.00	7	808.00	7	816.00	4	864.00	3	939.00	3	952.00	3	1310.00	5	4590.00	2
1955	660.00	4	660.00	3	674.00	3	697.00	3	840.00	5	964.00	8	1020.00	7	1110.00	6	1160.00	3	6440.00	6
1956	1000.00	17	1020.00	16	1050.00	16	1090.00	15	1250.00	18	1850.00	27	3010.00	37	3770.00	37	4730.00	34	10500.00	21
1957	990.00	15	950.00	14	1000.00	14	1050.00	13	1090.00	12	1260.00	12	1610.00	14	1880.00	18	2940.00	19	8290.00	12
1958	1510.00	41	1910.00	41	1980.00	40	2070.00	40	2320.00	40	2660.00	37	3020.00	38	4270.00	39	10300.00	44	17500.00	40
1959	3000.00	45	3000.00	45	3000.00	45	3070.00	45	3330.00	44	4770.00	45	5780.00	45	7060.00	45	10700.00	43	18000.00	43
1960	1400.00	25	1400.00	27	1420.00	26	1590.00	31	1930.00	35	2260.00	33	2450.00	31	2760.00	31	3420.00	25	6400.00	14
1961	1350.00	27	1400.00	28	1440.00	28	1440.00	26	1490.00	26	1520.00	19	1820.00	17	1670.00	13	1900.00	10	9390.00	20
1962	1540.00	33	1540.00	33	1540.00	32	1540.00	30	1600.00	27	1870.00	24	2040.00	24	2400.00	25	3470.00	27	14900.00	34
1963	1900.00	40	1900.00	40	1930.00	39	2050.00	39	2160.00	38	2440.00	34	2400.00	30	2560.00	27	2940.00	20	8850.00	17
1964	670.00	6	677.00	4	690.00	4	703.00	4	795.00	2	879.00	4	880.00	2	944.00	2	1260.00	4	7140.00	8
1965	785.00	10	806.00	10	815.00	8	825.00	8	875.00	7	912.00	5	974.00	4	1080.00	5	1600.00	7	6720.00	15
1966	1640.00	36	1660.00	36	1850.00	38	1970.00	37	2000.00	36	2220.00	32	2380.00	29	2730.00	29	3060.00	23	7140.00	9
1967	1150.00	23	1170.00	23	1190.00	23	1220.00	23	1350.00	21	1520.00	20	1560.00	14	1640.00	12	2280.00	14	9030.00	16
1968	1100.00	20	1110.00	20	1130.00	21	1140.00	18	1200.00	16	1420.00	16	1560.00	15	1730.00	14	2790.00	17	10800.00	22
1969	1620.00	35	1640.00	35	1660.00	35	1680.00	34	1780.00	32	2010.00	29	2500.00	32	4110.00	38	5300.00	37	15500.00	37
1970	2450.00	44	2520.00	44	2700.00	44	2950.00	44	3260.00	43	3790.00	41	4350.00	40	6290.00	43	8940.00	41	11400.00	27
1971	1410.00	30	1470.00	31	1630.00	33	1650.00	32	1720.00	31	2030.00	30	2280.00	28	2530.00	26	2900.00	21	10900.00	25
1972	1440.00	32	1460.00	30	1470.00	30	1510.00	29	1630.00	28	1970.00	28	2120.00	28	2180.00	28	3330.00	24	6920.00	7
1973	1430.00	31	1450.00	32	1540.00	31	1670.00	33	1680.00	34	2430.00	33	2920.00	35	3390.00	32	5730.00	38	15600.00	38

HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1		3		7		15		30		60		90		120		183		ANNUAL	
1929	73100.0	22	72500.0	22	70300.0	20	60000.0	18	40400.0	23	37000.0	20	30500.0	14	29000.0	12	26900.0	6	16100.0	8
1930	134000.0	3	174000.0	4	114000.0	4	94300.0	3	63500.0	4	44600.0	6	37800.0	6	31400.0	8	22900.0	12	12500.0	19
1931	18600.0	44	18200.0	44	16200.0	44	13300.0	43	9960.0	43	7940.0	43	6280.0	43	5370.0	43	4600.0	43	3140.0	43
1932	84000.0	16	82300.0	16	78700.0	16	69500.0	9	57100.0	9	39400.0	11	31200.0	15	28100.0	15	20400.0	19	12800.0	18
1933	114000.0	5	112000.0	5	102000.0	6	76800.0	6	52700.0	5	49400.0	4	44300.0	4	39300.0	3	35400.0	2	20600.0	2
1934	25200.0	42	24500.0	42	21300.0	42	15000.0	42	10900.0	42	8430.0	42	6440.0	42	5730.0	42	4860.0	42	3670.0	42
1935	48000.0	35	47500.0	35	45000.0	35	42200.0	30	32100.0	32	22900.0	34	21300.0	34	19200.0	32	14600.0	32	8640.0	33
1936	37600.0	40	36400.0	40	32700.0	40	27600.0	40	24000.0	39	20600.0	38	16900.0	39	13700.0	40	10500.0	40	3930.0	41
1937	142000.0	1	179000.0	1	168000.0	1	144000.0	1	100000.0	1	62100.0	2	44900.0	3	39000.0	4	29400.0	4	17400.0	4
1938	71000.0	23	68300.0	23	59800.0	25	56300.0	23	53000.0	7	40700.0	8	31300.0	12	27500.0	13	22200.0	15	14600.0	10
1939	102000.0	9	98600.0	9	87900.0	9	64200.0	13	42300.0	20	39900.0	9	37000.0	7	30400.0	9	22700.0	13	12800.0	17
1940	77400.0	19	75900.0	19	70700.0	19	54500.0	24	35500.0	29	21200.0	38	17400.0	38	14800.0	38	11000.0	39	6070.0	39
1941	20800.0	43	20200.0	43	18200.0	43	12600.0	44	8080.0	45	4900.0	45	4480.0	45	3790.0	45	3190.0	45	2140.0	45
1942	59000.0	30	57400.0	29	52200.0	30	36600.0	34	27300.0	35	24700.0	31	22400.0	30	19300.0	31	18500.0	25	10100.0	28
1943	97400.0	11	93800.0	11	82100.0	12	64900.0	10	49000.0	15	28200.0	25	31200.0	13	25400.0	17	20500.0	18	12100.0	22
1944	91200.0	14	90500.0	14	81200.0	13	61600.0	16	44500.0	16	31400.0	22	24900.0	25	20100.0	28	13900.0	35	7700.0	37
1945	105000.0	8	102000.0	4	96700.0	7	76600.0	7	56700.0	6	45500.0	5	35900.0	8	33600.0	9	25100.0	9	13000.0	11
1946	45000.0	38	43800.0	38	40300.0	34	31200.0	38	24200.0	38	22200.0	39	21400.0	33	18900.0	33	17500.0	24	12000.0	23
1947	60200.0	28	59400.0	29	58600.0	27	49200.0	28	40500.0	21	38200.0	13	32300.0	18	28100.0	18	22400.0	14	13300.0	14
1948	75200.0	21	72600.0	21	63400.0	26	50400.0	25	48200.0	13	31500.0	21	25500.0	22	20800.0	26	16000.0	30	9560.0	30
1949	110000.0	6	109000.0	6	104000.0	5	93500.0	4	79300.0	3	57200.0	3	47300.0	2	41100.0	2	30300.0	3	17400.0	5
1950	136000.0	2	136000.0	2	129000.0	2	119000.0	2	95500.0	2	77400.0	1	61100.0	1	53300.0	1	39700.0	1	22800.0	1
1951	69300.0	24	68600.0	24	65400.0	22	56600.0	22	39600.0	24	34500.0	18	31900.0	11	30200.0	10	27600.0	5	16400.0	7
1952	76500.0	20	74000.0	20	67700.0	21	57300.0	20	40500.0	22	34200.0	15	33500.0	9	31500.0	7	24200.0	7	15400.0	9
1953	40000.0	35	38900.0	35	35200.0	34	27600.0	39	23600.0	40	18600.0	40	17600.0	37	15100.0	37	12900.0	38	7440.0	38
1954	12300.0	45	11900.0	45	10900.0	45	10200.0	45	9050.0	44	7140.0	44	6010.0	44	5330.0	44	4230.0	44	2620.0	44
1955	45600.0	37	44400.0	37	41000.0	37	35500.0	36	33200.0	30	24400.0	30	20500.0	36	17500.0	36	13800.0	36	8020.0	35
1956	60000.0	29	57200.0	30	45800.0	34	39000.0	33	32500.0	31	26600.0	29	23700.0	28	21200.0	24	18200.0	23	12400.0	20
1957	84000.0	17	82000.0	17	75200.0	17	56800.0	21	39200.0	26	35500.0	16	31200.0	14	29000.0	11	23100.0	11	13300.0	15
1958	96200.0	15	95900.0	15	79300.0	15	65700.0	12	43500.0	14	29900.0	23	24900.0	26	23600.0	21	18900.0	22	14500.0	8
1959	97500.0	10	93500.0	12	91100.0	14	59500.0	19	46600.0	12	37000.0	14	29800.0	18	29200.0	19	19900.0	20	12300.0	21
1960	57900.0	31	55700.0	32	51000.0	32	39100.0	32	26200.0	37	18800.0	39	15400.0	40	14400.0	39	14800.0	31	9790.0	29
1961	132000.0	4	129000.0	3	119000.0	3	85700.0	5	60100.0	5	42400.0	7	39400.0	5	32700.0	6	23200.0	10	12600.0	16
1962	55000.0	33	54700.0	33	52100.0	31	43200.0	29	30800.0	28	27200.0	27	25400.0	23	21400.0	23	18500.0	29	10400.0	28
1963	82500.0	14	81000.0	18	71200.0	18	61700.0	15	51200.0	11	33100.0	19	24800.0	27	19900.0	29	14100.0	34	8230.0	34
1964	108000.0	7	104000.0	7	92400.0	8	71000.0	8	45200.0	14	39600.0	10	29300.0	19	23700.0	20	14700.0	27	8910.0	31
1965	47500.0	36	46500.0	36	44500.0	36	32400.0	37	27900.0	34	21000.0	37	21700.0	32	18000.0	34	13400.0	37	7820.0	36
1966	31800.0	41	31100.0	41	29400.0	41	23200.0	41	18100.0	41	17700.0	41	12600.0	41	11900.0	41	9840.0	41	6000.0	40
1967	61400.0	27	60600.0	27	56600.0	28	41600.0	31	29400.0	33	23600.0	33	22700.0	29	19900.0	30	19000.0	21	11100.0	24
1968	96000.0	12	94200.0	10	84600.0	11	62000.0	14	39600.0	29	27700.0	26	26300.0	21	23100.0	22	21400.0	18	13400.0	12
1969	94600.0	13	92900.0	13	84900.0	10	66000.0	11	51900.0	10	35200.0	17	27100.0	20	25400.0	18	20800.0	17	13400.0	13
1970	51200.0	34	50200.0	34	46100.0	33	35600.0	35	26600.0	36	23800.0	32	22000.0	31	20900.0	25	14900.0	28	10700.0	25
1971	63500.0	26	62600.0	26	59100.0	26	49600.0	27	37200.0	27	26800.0	28	20800.0	35	17600.0	35	14300.0	33	8830.0	32
1972	66900.0	25	66300.0	25	64600.0	23	61000.0	17	43200.0	19	29300.0	24	24900.0	24	20700.0	27	17100.0	25	10100.0	27
1973	57800.0	32	56400.0	31	55700.0	29	49800.0	24	43800.0	17	38300.0	12	29900.0	17	26900.0	14	25600.0	8	17800.0	3

APPENDIX D-2 (CONTINUED)

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                    STATISTICS ON NORMAL MONTHLY MEANS(ALL DAYS)

       OCT          NOV          DEC          JAN          FEB        MARCH        APRIL         MAY          JUNE         JULY          AUG          SEPT

                    BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.2652E+04 0.5197E+04 0.8949E+04 0.1792E+05 0.1812E+05 0.2213E+05 0.2159E+05 0.1621E+05 0.1021E+05 0.6841E+04 0.3742E+04 0.2609E+04
0.5289E+07 0.2927E+08 0.7503E+08 0.4665E+09 0.1906E+09 0.1587E+09 0.1310E+09 0.1486E+09 0.5375E+08 0.3230E+08 0.8597E+07 0.2804E+07
0.2300E+04 0.5410E+04 0.8662E+04 0.2160E+05 0.1380E+05 0.1260E+05 0.1145E+05 0.1219E+05 0.7332E+04 0.5683E+04 0.2932E+04 0.1675E+04
0.2438E+01 0.1726E+01 0.1322E+01 0.2032E+01 0.1213E+01 0.5144E+00 0.4499E+00 0.1536E+01 0.1320E+01 0.1815E+01 0.3506E+01 0.2213E+01
0.8673E+00 0.1041E+01 0.9679E+00 0.1205E+01 0.7618E+00 0.5693E+00 0.5302E+00 0.7521E+00 0.7178E+00 0.8307E+00 0.7836E+00 0.6418E+00
0.1947E+01 0.3816E+01 0.6572E+01 0.1316E+02 0.1331E+02 0.1625E+02 0.1585E+02 0.1190E+02 0.7500E+01 0.5024E+01 0.2746E+01 0.1916E+01


                    STATISTICS ON NORMAL ANNUAL MEANS(ALL DAYS)

          MEAN              VARIANCE          STANDARD DEVIATION        SKEWNESS          COEFF. OF VARIATION        SERIAL CORR
       0.1131E+05          0.2116E+08            0.4600E+04            0.1076E+00             0.4067E+00             0.2490E+00

                    STATISTICS ON LOG MONTHLY MEANS(ALL DAYS)

       OCT          NOV          DEC          JAN          FEB        MARCH        APRIL         MAY          JUNE         JULY          AUG          SEPT

                    BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.3315E+01 0.3517E+01 0.3734E+01 0.3909E+01 0.4104E+01 0.4255E+01 0.4264E+01 0.4100E+01 0.3908E+01 0.3714E+01 0.3488E+01 0.3351E+01
0.8393E-01 0.1716E+00 0.2153E+00 0.2460E+00 0.1727E+00 0.9995E-01 0.6640E-01 0.1036E+00 0.9190E-01 0.1064E+00 0.7073E-01 0.5388E-01
0.2897E+00 0.4142E+00 0.4640E+00 0.4960E+00 0.4156E+00 0.3161E+00 0.2577E+00 0.3218E+00 0.3031E+00 0.3261E+00 0.2659E+00 0.2321E+00
0.7507E+00 0.3741E+00-0.3536E-01 0.6540E-01-0.6909E+00-0.1076E+01-0.6322E+00-0.2657E+00 0.4229E-01 0.1412E+00 0.1917E+00 0.5074E+00
0.8738E-01 0.1178E+00 0.1243E+00 0.1243E+00 0.1013E+00 0.7430E-01 0.6040E-01 0.7850E-01 0.7758E-01 0.8781E-01 0.7624E-01 0.6928E-01
0.7248E+01 0.7690E+01 0.8163E+01 0.8721E+01 0.8972E+01 0.9303E+01 0.9327E+01 0.8962E+01 0.8543E+01 0.8119E+01 0.7626E+01 0.7325E+01


                    STATISTICS ON LOG ANNUAL MEANS(ALL DAYS)

          MEAN              VARIANCE          STANDARD DEVIATION        SKEWNESS          COEFF. OF VARIATION        SERIAL CORR
       0.4007E+01          0.5018E-01            0.2240E+00           -0.1306E+01             0.5590E-01             0.1732E+00

                    ANNUAL PEAKS


                         1907     190000                              1949     110000
                         1913     235000                              1950     140000
                         1925      27400                              1951      69300
                         1926      54200                              1952      76500
                         1927     102000                              1953      40500
                         1928      52000                              1954      12300
                         1929      73100                              1955      45600
                         1930     159000                              1956      60000
                         1931      18600                              1957      84600
                         1932      84000                              1958      92300
                         1933     114000                              1959     100000
                         1934      25200                              1960      57900
                         1935      48500                              1961     132000
                         1936      38300                              1962      55900
                         1937     103000                              1963      82500
                         1938      71000                              1964     100000
                         1939     104000                              1965      48000
                         1940      77400                              1966      32100
                         1941      21300                              1967      62000
                         1942      59000                              1968      96660
                         1943      98900                              1969      94800
                         1944      91200                              1970      51600
                         1945     105000                              1971      64300
                         1946      45500                              1972      67000
                         1947      60200                              1973      50600
                         1948      77000
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APPENDIX D-3. STATISTICAL STREAM FLOW DATA FOR BUSSERON CREEK (10).

03342500 Busseron Creek near Carlisle, Ind.

LOCATION.--Lat 38°58'26", long 87°25'33", in NW¼ survey 17, Vincennes Tract, Sullivan County, on left bank 10 ft (3 m) downstream from bridge on State Highway 58, 1.5 miles (2.4 km) northwest of Carlisle, and 6.8 miles (10.9 km) upstream from mouth.

DRAINAGE AREA.--228 mi² (591 km²).

REMARKS.--Flow affected by Soil Conservation Service floodwater-retarding structures and surface-mined areas.

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

NUMBER OF DAYS IN CLASS

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
YEAR																																				CFS-DAYS
1944				3	18	22	9	47	28	36	16	9	14	26	24	12	3	9	10	12	11	15	9	11	9	3		2	1	3	3	1				44608.6
1945								4	20	34	45	31	18	14	21	17	7	11	8	20	13	17	9	10	12	9	8	14	7	9	6	1				110941.2
1946								10	26	14	8	7	5	5	21	31	24	24	20	30	22	26	19	15	16	11	14	9	6	2						74792.4
1947					3	8	3	7	12	3	4	15	17	15	19	18	30	18	32	21	23	19	20	11	13	16	7	23	5	3						83958.1
1948									4	3	21	34	19	42	29	42	27	18	13	23	13	11	10	3	13	7	20	4	6	4						66194.8
1949													7	18	31	27	17	20	33	37	30	36	21	13	12	15	12	9	12	12	3					121051.2
1950										4	11	8	4	8	13	20	33	23	20	30	24	22	17	15	16	13	17	29	10	16	6	4	1	1		200136.7
1951									2	5	10	13	13	8	23	38	21	21	24	24	31	24	22	8	22	12	13	20	8	3						94073.1
1952									5	23	25	14	11	9	18	18	17	17	12	14	32	30	23	15	12	17	12	27	7	5	3					115793.9
1953		1	3	1	4	4	10	23	41	17	12	26	18	12	21	15	17	17	25	15	17	17	10	11	11	4	9			1	3					42286.0
1954	26	32	9	3	36	13	36	27	13	25	18	15	15	19	20	13	18	13	7	1	1	1	2	2												3929.6
1955	6	10	10	2	7	5	10	15	27	22	16	11	8	8	19	15	28	26	21	19	25	9	12	8	7	5	9	4	1							35944.1
1956									5	26	2	3	11	17	33	40	28	26	30	24	25	26	16	15	9	11	1	9	4	4	1					64172.6
1957									9	19	6	9	8	15	26	37	28	29	29	22	24	23	13	13	13	6	9	7	10	3	2	5				108914.8
1958													9	14	22	17	23	21	45	58	31	29	16	13	10	10	10	14	16	3	1	3				114860.0
1959												8	14	19	53	27	22	29	26	27	31	24	15	14	14	12	9	7	8	3	3					83865.9
1960									14	18	14	12	11	8	16	15	29	20	47	36	26	26	17	17	7	13	8	11	1							58598.1
1961									10	23	26	42	57	25	17	14	20	17	14	10	12	17	17	13	8	6	3	4	4	1	1	1	3			68672.5
1962											6	13	17	32	22	28	31	27	24	21	26	40	20	12	10	7	9	10	6	2	2					74812.4
1963		2	2	3	5	3	2	6	3	3	18	22	19	32	51	42	23	31	29	8	11	5	10	8	6	2	5	4	3	4	3					51052.0
1964						1	4	17	20	27	25	28	42	34	27	25	25	11	14	14	11	13	7	4	5	3	1	3	3	2						29635.2
1965									7	3	18	34	62	27	25	19	17	16	28	29	15	16	13	11	9	4	6	3	2	1						38574.0
1966			3	1	5	2	8	10	22	14	18	23	39	22	22	28	16	15	24	20	13	23	11	8	1	6	4	1	6							33741.3
1967											13	35	23	14	29	14	10	11	26	34	33	22	22	20	9	9	12	19	4	2	2	2				93538.9
1968											4	26	18	10	28	23	30	35	27	24	28	24	17	14	17	9	7	8	6	8	3					89349.7
1969												24	13	20	22	16	26	35	39	25	30	28	19	13	11	6	11	12	5	6	1	3				99136.7
1970												1	15	27	19	15	26	28	36	36	43	26	22	20	8	13	7	11	10	2						80621.2
1971												8	24	28	28	20	66	40	32	33	16	22	14	8	5	3	2	11	2	3						49827.5
1972											3	31	58	36	22	28	13	29	38	35	14	19	5	7	6	5	4	4	7	2						47550.9
1973												1	23	12	8	13	11	17	24	35	28	25	27	33	32	18	13	24	12	9						134694.8

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.00	32	10958	100.0	9	2.20	319	10189	93.0	18	48.0	757	5076	46.3	27	1000	303	656	5.9
1	0.10	45	10926	99.7	10	3.10	339	9870	90.1	19	67.0	737	4319	39.4	28	1500	172	353	3.2
2	0.20	27	10881	99.3	11	4.30	503	9531	87.0	20	95.0	651	3582	32.7	29	2100	113	181	1.6
3	0.30	13	10854	99.1	12	6.10	612	9028	82.4	21	130.0	635	2931	26.7	30	2900	43	68	.6
4	0.40	78	10841	98.9	13	8.60	576	8416	76.8	22	190.0	455	2296	21.0	31	4100	20	25	.2
5	0.60	58	10763	98.2	14	12.00	729	7840	71.5	23	260.0	365	1841	16.8	32	5800	4	5	
6	0.80	82	10705	97.7	15	17.00	687	7111	64.9	24	370.0	323	1476	13.5	33	8200	1	1	
7	1.10	166	10623	96.9	16	24.00	694	6424	58.6	25	530.0	255	1153	10.5	34				
8	1.50	268	10457	95.4	17	34.00	654	5730	52.3	26	740.0	242	898	8.2					

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1		3		7		14		30		60		90		120		183		ANNUAL	
1945	0.40	5	0.40	5	0.50	5	0.60	4	0.80	4	1.90	3	3.20	3	3.10	2	3.70	2	176.00	12
1946	2.80	17	2.90	17	3.00	16	4.00	14	6.50	18	46.20	28	71.90	27	88.30	27	106.00	25	340.00	25
1947	0.60	7	0.60	7	0.60	6	1.00	5	1.90	7	2.80	6	10.40	11	10.80	10	28.90	10	164.00	11
1948	0.40	6	0.46	6	0.80	7	1.10	6	3.10	11	16.60	21	19.30	18	29.70	18	29.70	11	259.00	19
1949	1.90	14	2.00	14	2.40	14	5.70	21	8.90	22	15.50	19	41.50	24	44.20	22	61.10	22	346.00	26
1950	6.10	26	6.20	24	7.70	25	13.70	29	36.30	29	70.90	29	76.20	28	93.10	28	106.00	26	460.00	29
1951	2.50	16	2.80	16	3.30	17	4.10	16	5.60	16	17.10	22	83.70	29	138.00	29	150.00	28	322.00	24
1952	2.00	15	2.10	15	2.90	15	4.00	15	4.90	13	25.60	26	41.70	25	64.00	23	69.10	23	304.00	23
1953	1.20	10	1.30	10	1.50	10	1.60	9	1.70	6	3.50	8	9.90	10	10.30	9	12.80	7	156.00	10
1954	0.10	3	0.20	4	0.30	4	0.50	3	0.60	2	1.10	1	1.20	1	1.40	1	1.80	1	36.20	1
1955	0.00	1	0.00	1	0.00	1	0.00	1	0.00	1	1.40	2	3.70	6	3.30	3	4.30	3	59.10	2
1956	0.80	8	0.90	8	1.20	8	1.30	8	1.50	5	5.00	11	29.00	23	39.90	21	46.00	19	143.00	9
1957	1.50	11	1.60	11	1.80	11	2.10	11	2.30	10	4.40	9	5.90	8	8.30	7	23.60	9	128.00	8
1958	7.60	27	7.70	27	8.00	26	8.50	25	12.90	25	15.50	20	24.00	20	66.30	24	193.00	29	410.00	28
1959	11.00	29	11.00	29	11.90	29	12.90	28	14.90	26	26.30	27	26.30	21	82.90	26	121.00	27	286.00	22
1960	5.40	23	6.20	25	6.60	23	8.40	24	15.80	27	25.50	25	27.90	22	33.70	19	49.50	21	185.00	13
1961	1.60	13	1.70	12	1.90	12	2.10	12	2.20	8	2.80	7	3.60	5	5.30	5	6.10	5	95.70	7
1962	3.30	18	3.50	18	4.10	18	4.50	18	5.60	14	8.90	14	11.40	12	23.70	15	34.10	13	260.00	20
1963	5.80	24	6.10	23	6.90	24	9.50	26	11.40	23	17.80	23	23.50	19	34.10	20	36.40	15	189.00	14
1964	0.10	2	0.10	2	0.30	2	0.40	2	0.80	3	2.60	4	3.10	2	3.70	4	5.10	4	74.10	4
1965	1.20	9	1.30	9	1.40	9	1.90	10	3.70	12	5.00	10	5.60	7	5.80	6	8.40	6	88.30	5
1966	1.50	12	1.70	13	2.10	13	3.90	13	6.60	19	6.90	12	13.10	14	26.60	17	41.40	16	91.00	6
1967	0.20	4	0.20	3	0.30	3	1.10	7	2.20	9	2.70	5	3.50	4	9.90	8	17.00	8	223.00	16
1968	3.50	19	3.70	19	4.10	19	4.30	17	5.60	15	12.70	16	16.60	16	22.10	14	42.30	17	223.00	17
1969	4.60	22	4.70	22	4.80	21	5.20	19	5.80	17	7.30	13	7.50	9	18.30	13	34.50	14	279.00	21
1970	8.90	28	9.30	28	9.70	28	12.50	27	18.70	28	21.90	24	51.30	26	79.20	25	103.00	24	239.00	18
1971	6.00	25	7.00	26	8.20	27	8.30	23	12.50	24	15.20	18	19.00	17	25.10	16	47.10	20	194.00	15
1972	4.30	21	4.40	21	6.10	22	6.70	22	8.00	21	14.00	17	14.10	15	15.70	12	30.90	12	72.60	3
1973	3.80	20	4.10	20	4.40	20	5.20	20	7.60	20	12.50	15	12.60	13	14.40	11	44.10	18	347.00	27

APPENDIX D-3 (CONTINUED)

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                HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR          1            3            7           15           30           60           90          120          183         ANNUAL
1944      4590.0  7    3710.0  8    2270.0 10    1660.0  9    1030.0 12     612.0 14     462.0 17     355.0 20     240.0 22     122.0 24
1945      5070.0  5    4020.0  6    2930.0  7    1800.0  6    1270.0  6    1020.0  3     833.0  3     837.0  2     592.0  3     304.0  6

1946      2720.0 18    2420.0 19    1720.0 20    1090.0 20     817.0 20     475.0 23     396.0 21     421.0 18     348.0 16     205.0 15
1947      2600.0 20    2170.0 23    1640.0 23    1060.0 21     922.0 15     737.0 10     575.0 10     450.0 15     410.0 11     230.0 12
1948      2780.0 17    2450.0 18    1720.0 21     945.0 23     940.0 14     612.0 15     469.0 15     450.0 16     316.0 18     181.0 18
1949      3720.0  9    3300.0 11    2370.0  8    1990.0  5    1540.0  2    1100.0  2     914.0  2     784.0  3     564.0  5     332.0  3
1950      8500.0  1    7020.0  2    4810.0  1    3400.0  1    2460.0  1    1860.0  1    1440.0  1    1260.0  1     921.0  1     548.0  1

1951      2670.0 19    2540.0 17    1880.0 16    1410.0 14     874.0 17     648.0 13     564.0 12     539.0  8     454.0  8     258.0  9
1952      3540.0 11    3260.0 12    1980.0 15    1850.0  7    1230.0  7     837.0  7     713.0  7     648.0  7     588.0  4     316.0  4
1953      3380.0 13    3330.0 10    2000.0 14    1170.0 18     833.0 19     527.0 18     400.0 20     316.0 21     224.0 25     116.0 25
1954       325.0 30     221.0 30     116.0 30      63.5 30      56.5 30      37.2 30      29.2 30      25.0 30      18.3 30      10.8 30
1955      1800.0 27    1570.0 28     862.0 28     573.0 28     374.0 29     352.0 26     266.0 27     231.0 27     174.0 28      98.2 27

1956      3220.0 15    2890.0 15    1620.0 24     805.0 26     600.0 24     380.0 25     324.0 24     306.0 24     280.0 19     175.0 19
1957      4900.0  6    4500.0  5    3210.0  5    1730.0  8    1200.0 10     987.0  5     793.0  4     673.0  4     502.0  6     276.0  7
1958      5200.0  4    4750.0  4    3320.0  4    2180.0  4    1280.0  5     826.0  9     640.0  9     498.0 11     393.0 12     315.0  5
1959      3100.0 16    2880.0 16    2020.0 13    1240.0 17    1030.0 11     709.0 11     571.0 11     496.0 12     390.0 13     230.0 13
1960      1510.0 29    1130.0 29     809.0 29     550.0 29     443.0 27     338.0 27     291.0 25     297.0 25     244.0 21     155.0 20

1961      8160.0  2    7050.0  1    4710.0  2    2380.0  2    1370.0  4     834.0  8     676.0  8     535.0  9     367.0 14     188.0 17
1962      3340.0 14    2950.0 14    1720.0 22    1060.0 22     730.0 22     500.0 21     501.0 14     464.0 14     348.0 17     203.0 16
1963      3650.0 10    3520.0  9    2190.0 11    1540.0 12    1230.0  8     659.0 12     461.0 18     364.0 19     256.0 20     140.0 21
1964      2570.0 21    2260.0 21    1530.0 25     810.0 24     567.0 25     408.0 24     283.0 26     218.0 28     154.0 29      81.0 29
1965      2310.0 23    2070.0 26    1170.0 27     592.0 27     443.0 28     286.0 29     245.0 29     209.0 29     190.0 26     106.0 26

1966      1730.0 28    1640.0 27    1510.0 26     806.0 25     549.0 26     336.0 28     252.0 28     231.0 26     176.0 27      92.4 28
1967      4460.0  8    3990.0  7    2970.0  6    1640.0 10     960.0 13     575.0 17     467.0 16     480.0 13     444.0 10     256.0 10
1968      3450.0 12    3040.0 13    2270.0  9    1320.0 15     704.0 21     589.0 16     541.0 13     533.0 10     449.0  9     244.0 11
1969      5710.0  3    5340.0  3    3830.0  3    2290.0  3    1530.0  3     883.0  6     739.0  5     663.0  5     480.0  7     272.0  8
1970      2200.0 25    2150.0 24    1760.0 19    1100.0 19     644.0 23     495.0 22     459.0 19     424.0 17     356.0 15     221.0 14

1971      2190.0 26    2180.0 22    1780.0 17    1280.0 16     863.0 18     510.0 20     390.0 23     310.0 22     238.0 23     137.0 22
1972      2300.0 24    2090.0 25    2050.0 12    1550.0 11     901.0 16     523.0 19     392.0 22     308.0 23     236.0 24     130.0 23
1973      2440.0 22    2290.0 20    1770.0 18    1420.0 13    1210.0  9     935.0  4     717.0  6     648.0  6     628.0  2     369.0  2

            STATISTICS ON NORMAL MONTHLY MEANS(ALL DAYS)

    OCT        NOV        DEC        JAN        FEB       MARCH      APRIL       MAY        JUNE       JULY        AUG        SEPT

            BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.3379E+02 0.1354E+03 0.2153E+03 0.3309E+03 0.3471E+03 0.4193E+03 0.4239E+03 0.2760E+03 0.1879E+03 0.8604E+02 0.3634E+02 0.4252E+02
0.2990E+04 0.3449E+05 0.8186E+05 0.2430E+06 0.1018E+06 0.9449E+05 0.9757E+05 0.7964E+05 0.4774E+05 0.1004E+05 0.2228E+04 0.7850E+04
0.5468E+02 0.1857E+03 0.2861E+03 0.4930E+03 0.3191E+03 0.3074E+03 0.3124E+03 0.2822E+03 0.2185E+03 0.1002E+03 0.4720E+02 0.8860E+02
0.3006E+01 0.1813E+01 0.2062E+01 0.3115E+01 0.1259E+01 0.9961E+00 0.6843E+00 0.1773E+01 0.2170E+01 0.1987E+01 0.3040E+01 0.4729E+01
0.1618E+01 0.1372E+01 0.1329E+01 0.1490E+01 0.9193E+00 0.7330E+00 0.7369E+00 0.1022E+01 0.1163E+01 0.1165E+01 0.1299E+01 0.2084E+01
0.1333E+C1 C.5342E+01 C.8495E+01 0.1306E+02 0.1370E+02 0.1655E+02 0.1673E+02 0.1089E+02 0.7410E+01 0.3395E+01 0.1434E+01 0.1678E+01


            STATISTICS ON NORMAL ANNUAL MEANS(ALL DAYS)

      MEAN              VARIANCE        STANDARD DEVIATION          SKEWNESS          COEFF. OF VARIATION        SERIAL CORR
   0.2103E+03          0.1148E+05           0.1071E+03             0.9300E+00             0.5094E+00              0.3748E+00
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APPENDIX D-3 (CONTINUED)

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            STATISTICS ON LOG MONTHLY MEANS(ALL DAYS)

   OCT        NOV        DEC        JAN        FEB       MARCH      APRIL       MAY        JUNE       JULY       AUG        SEPT

            BY ROWS(MEAN,VARIANCE,STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION,PERCENTAGE OF AVERAGE FLOW)
0.1146E+01 0.1626E+01 0.1867E+01 0.2127E+01 0.2301E+01 0.2485E+01 0.2477E+01 0.2238E+01 0.2004E+01 0.1531E+01 0.1286E+01 0.1174E+01
0.3419E+00 0.6682E+00 0.5862E+00 0.4653E+00 0.2937E+00 0.1829E+00 0.1699E+00 0.1903E+00 0.2786E+00 0.6896E+00 0.2628E+00 0.4463E+00
0.5847E+00 0.7795E+00 0.7656E+00 0.6821E+00 0.5419E+00 0.4038E+00 0.4122E+00 0.4363E+00 0.5278E+00 0.8304E+00 0.5124E+00 0.6681E+00
0.2455E+00-0.2817E+00-0.4008E+00-0.5600E+00-0.7574E+00-0.1285E+01-0.7131E+00 0.7962E-01-0.2141E+00-0.1767E+01 0.2071E-01-0.1206E+00
0.5101E+00 0.4797E+00 0.4101E+00 0.3206E+00 0.2355E+00 0.1624E+00 0.1664E+00 0.1949E+00 0.2834E+00 0.5423E+00 0.3985E+00 0.5691E+00
0.5149E+01 0.7302E+01 0.8386E+01 0.9555E+01 0.1034E+02 0.1116E+02 0.1113E+02 0.1005E+02 0.9002E+01 0.6879E+01 0.5776E+01 0.5273E+01



            STATISTICS ON LOG ANNUAL MEANS(ALL DAYS)

        MEAN             VARIANCE        STANDARD DEVIATION       SKEWNESS        COEFF. OF VARIATION     SERIAL CORR
     0.2250E+01         0.9240E-01          0.3040E+00          -0.2205E+01           0.1551E+00           0.3651E+00

            ANNUAL PEAKS

                  1944      4700
                  1945      5500
                  1946      2900
                  1947      2720
                  1948      3100
                  1949      4200
                  1950      8800
                  1951      2500
                  1952      4070
                  1953      3890
                  1954       430
                  1955      2040
                  1956      3980
                  1957      5200
                  1958      5400
                  1959      3100
                  1960      1690
                  1961      8580
                  1962      3570
                  1963      3970
                  1964      2750
                  1965      2600
                  1966      1920
                  1967      4740
                  1968      3540
                  1969      5880
                  1970      2650
                  1971      2460
                  1972      2400
                  1973      2620
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APPENDIX E

LOW-FLOW CHARACTERISTICS FOR SELECTED STREAMS IN KNOX COUNTY (11)

APPENDIX E-1. LOW-FLOW CHARACTERISTICS OF THE WABASH RIVER (11).

LOCATION.--Lat 38°42'26", long 87°31'10", Knox County, near center of span on downstream side of bridge on U.S. Highway 50 at Indiana-Illinois State line, 5.0 miles downstream from Maria Creek, 7.5 miles upstream from Embarras River, and at mile 129.6.

DRAINAGE AREA.--13,700 sq mi, approximately.

DISCHARGE DATA AVAILABLE.--October 1929 to September 1967.

SELECTED DISCHARGE CHARACTERISTICS.--

Average discharge:	11,120 cfs (38 years)
Minimum daily discharge:	770 cfs August 1934
1-day, 30-year low flow:	890 cfs

WATER INTAKES AND SEWER OUTFALLS.--Natural flow affected by storage reservoirs and power development.

Magnitude and frequency of annual low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	1,670	1,240	1,080	950	830
3	1,710	1,280	1,100	960	840
7	1,780	1,310	1,120	990	860
14	1,840	1,350	1,160	1,030	890
30	2,060	1,530	1,320	1,190	1,050
60	2,310	1,680	1,460	1,300	1,160

Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	2,510	1,690	1,300	1,010	740
3	2,600	1,720	1,330	1,040	770
7	2,720	1,790	1,380	1,090	800
14	3,070	1,920	1,480	1,160	860
30	3,600	2,200	1,660	1,310	1,000
60	4,960	2,810	2,090	1,590	1,160

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1930-67 water years							
		98	95	90	80	70	50	20	10
3	Aug.-Oct.	1,200	1,400	1,590	1,890	2,160	3,000	5,100	7,100
6	May-Oct.	1,280	1,560	1,820	2,340	3,020	4,850	11,400	18,500
3	June-Aug.	1,290	1,740	2,160	2,810	3,660	5,400	11,200	17,400
12	Oct.-Sept.	1,400	1,670	1,950	2,640	3,450	6,100	16,600	28,000

APPENDIX E-2. LOW-FLOW CHARACTERISTICS OF THE WHITE RIVER (11).

LOCATION.--Lat 38°30'39", Long 87°17'22", in SW 1/4 sec. 15, T. 1 N., R. 8 W., Pike County, on left bank 300 ft downstream from bridge on State Highway 61, 0.4 mile upstream from Prides Creek, 1 mile north of Petersburg, and at mile 47.7.

DRAINAGE AREA.--11,125 sq mi.

DISCHARGE DATA AVAILABLE.--October 1927 to September 1967. Monthly discharge only for October 1927. Published as "at Hazleton" October 1927 to September 1938.

SELECTED DISCHARGE CHARACTERISTICS.--
Average discharge: 11,180 cfs (40 years)
Minimum daily discharge: 573 cfs October 1941
1-day, 30-year low flow: 540 cfs

WATER INTAKES AND SEWER OUTFALLS.--Flow affected by upstream reservoirs.

Magnitude and frequency of annual low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	1,120	790	670	580	500
3	1,140	810	690	600	520
7	1,170	830	700	620	530
14	1,220	860	730	630	540
30	1,330	940	800	710	620
60	1,530	1,050	890	780	680

Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	2,040	1,320	1,010	790	570
3	2,130	1,370	1,050	820	600
7	2,200	1,440	1,110	870	640
14	2,400	1,560	1,200	940	690
30	2,810	1,740	1,320	1,040	760
60	4,000	2,220	1,630	1,250	910

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1938-67 water years							
		98	95	90	80	70	50	20	10
3	Aug.-Oct.	740	850	1,010	1,250	1,470	2,070	3,540	4,940
6	May-Oct.	810	990	1,210	1,630	2,200	3,600	9,300	15,600
3	June-Aug.	1,050	1,390	1,790	2,520	3,010	4,100	9,200	15,100
12	Oct.-Sept.	880	1,060	1,300	1,870	2,650	5,100	16,400	28,500

APPENDIX E-3. LOW-FLOW CHARACTERISTICS OF BUSSERON CREEK (11).

LOCATION.--Lat 38°58'30", long 87°25'35", in NW 1/4 survey 17, Vincennes Tract, Knox County, on right bank 10 ft downstream from bridge on State Highway 58, 1.5 miles northwest of Carlisle, and 6.8 miles upstream from mouth.

DRAINAGE AREA.--228 sq mi.

DISCHARGE DATA AVAILABLE.--October 1943 to September 1967.

SELECTED DISCHARGE CHARACTERISTICS.--
Average discharge: 206 cfs (24 years)
Minimum daily discharge: No flow for many days in 1954
1-day, 30-year low flow: 0 cfs

WATER INTAKES AND SEWER OUTFALLS.--Natural flow affected by temporary storage retention reservoirs and surface-mined areas.

Magnitude and frequency of annual low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years,				
	2	5	10	20	50
1	1.5	0.4	0.2	0	0
3	1.6	.4	.2	0	0
7	1.8	.6	.3	.1	0
14	2.6	.9	.5	.2	0
30	3.7	1.4	.8	.3	.1
60	7.5	2.8	1.7	1.1	.7

Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	2.8	1.0	0.5	0.2	0
3	3.0	1.1	.5	.2	0
7	3.5	1.3	.7	.3	.1
14	4.5	1.7	.9	.4	.1
30	8.3	2.7	1.5	.7	.2
60	30	8.6	4.1	2.2	1.1

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1944-67 water years							
		98	95	90	80	70	50	20	10
3	Aug.-Oct.	0.2	0.6	1.3	2.1	3.2	6.8	21	51
6	May-Oct.	.2	1.0	1.7	3.5	6.2	15	76	218
3	June-Aug.	.3	1.0	2.0	4.2	6.8	14	68	218
12	Oct.-Sept.	.6	1.3	2.5	5.4	11	32	193	530

APPENDIX E-4. LOW-FLOW CHARACTERISTICS OF MARIA CREEK (11).

LOCATION.--Lat 38°46'35", long 87°28'21", in NW 1/4 sec. 24, T. 4 N., R. 10 W., Knox County, at bridge on U.S. Highway 41, 2 miles south of Emison.

DRAINAGE AREA.--about 88 sq mi.

DISCHARGE DATA AVAILABLE.--Low-flow measurements, 1954, 1960-65, 1967 water years.

SELECTED DISCHARGE CHARACTERISTICS.--Minimum flow observed: No flow at times in 1954 water year
7-day, 2-year low flow: 1.4 cfs
7-day, 10-year low flow: .3 cfs
50% daily flow duration: 16 cfs
90% daily flow duration: 1.8 cfs

APPENDIX E-5. LOW-FLOW CHARACTERISTICS OF BLACK CREEK (11).

LOCATION.--Lat 38°52'38", long 87°11'12", at corner secs. 9, 10, 15, and 16, T. 5 N., R. 7 W., Knox County, at bridge on State Highway 58, 1.3 miles south of Sandborn.

DRAINAGE AREA.--109 sq mi.

DISCHARGE DATA AVAILABLE.--Low-flow measurements, 1960-63, 1965, 1967 water years.

SELECTED DISCHARGE CHARACTERISTICS.--Minimum flow observed: 6.2 cfs October 1964
7-day, 2-year low flow: 7.6 cfs
7-day, 10-year low flow: 2.5 cfs
50% daily flow duration: 38 cfs
90% daily flow duration: 10 cfs

APPENDIX F

LOESS THICKNESS MEASUREMENTS IN KNOX COUNTY (20)

APPENDIX F. LOESS THICKNESS MEASUREMENTS IN KNOX COUNTY (20).

Site No.	Township	Range	Section	Total Depth in Inches	Underlying Material
1	5N	9W	10, SE40, SW10	165	silty clay loam Illinoian Till
2	5N	9W	13, SW160, SW40	155	Illinoian Till
3	5N	8W	18, SE10	110	silty clay loam Illinoian Till
4	5N	8W	17, SE40, SW10	90	silty clay loam Illinoian till
5	5N	8W	22, NE160, NW10	70	silty clay loam Illinoian till
6	5N	8W	26, NW160, NE40	65	silty clay loam Illinoian till
7	5N	8W	35, NE160, SE40	70	silt loam Illinoian till
8	4N	8W	12, NE160, SW40	100	silt loam Illinoian till
9	5N	10W	36, SE10	250+	gray 100-200"
10	3N	10W	2, NE160	235	sandy loam Illinoian outwash
11	3N	10W	11, NE160	185	sandy loam Illinoian outwash
12	3N	10W	36, NE160	160	Illinoian outwash
13	3N	10W	Grant 3, middle of SW side	175	Illinoian drift
14	3N	9W	Grant 161, 1/4 mi. NW of E corner	105	silty clay loam
15	2N	9W	Grant 228, 1/4 mi. W of center	95	clay loam Illinoian outwash
16	2N	8W	29, SE160, SW10	110	silty clay loam Illinoian till
17	1N	8W	3, NW160, SE40	100	silty clay loam residuum
18	1N	8W	10, SW160, NW40	150	silty clay residuum
19	2N	10W	26, NE160, NW40	275	Illinoian outwash
20	4N	9W	Grant 95, NW40	110	silty clay loam Illinoian till
21	4N	9W	Grant 186, NW40	125	silt loam Illinoian till
22	4N	8W	Grant 142,	90	silt loam

APPENDIX F (CONTINUED)

Site No.	Township	Range	Section	Total Depth in Inches	Underlying Material
23	4N	8W	SW1/4, NE1/4 Grant 233, NE1/4, SE1/4	100	Illinoian till silt loam shale soil
24	4N	8W	15, SW160, SE40	120	silt loam Illinoian till
25	5N	7W	4, SW160, NW40	90	shale residuum
26	5N	8W	1, SE40, NE10	85	silty clay loam Illinoian till
27	5N	8W	25, SE160, NE40	105	silty clay loam Illinoian till
28	3N	9W	Grant 91, 1/4 mi. W of center	90	silt loam Illinoian till
29	3N	8W	Grant 108, NW1/4, NE1/4	100	silty clay loam Illinoian till
30	1N	9W	6, NW40	190	silt loam
31	2N	9W	Grant 174, NE1/4, NW1/4	115	Illinoian outwash
32	2N	9W	Grant 36, Hamlin Church	190	Illinoian outwash
33	1N	8W	2, NW160, SE40	125	silt loam Illinoian till
34	2N	8W	20, NE40	110	silty clay loam Illinoian till
35	3N	9W	31, SE10	85	undetermined
36	3N	9W	Grant 27, W1/4	113	Illinoian till
37	3N	9W	Grant 67, N1/4	66	Illinoian till
38	3N	9W	Grant 65, N1/4	72	silt loam
39	3N	8W	Grant 80, N1/4	54	Illinoian till
40	3N	8W	Grant109, N 1/4	74	Illinoian till

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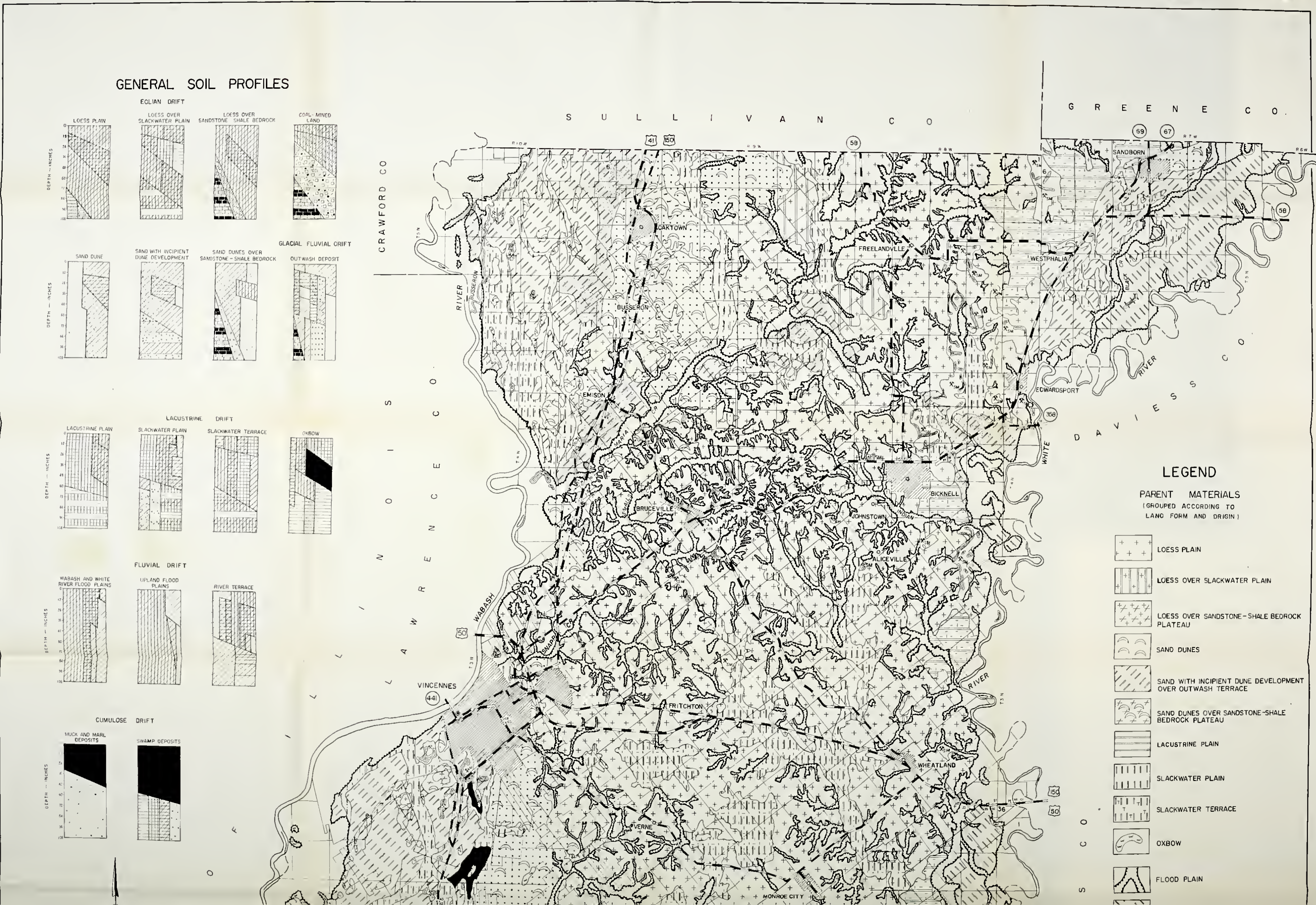
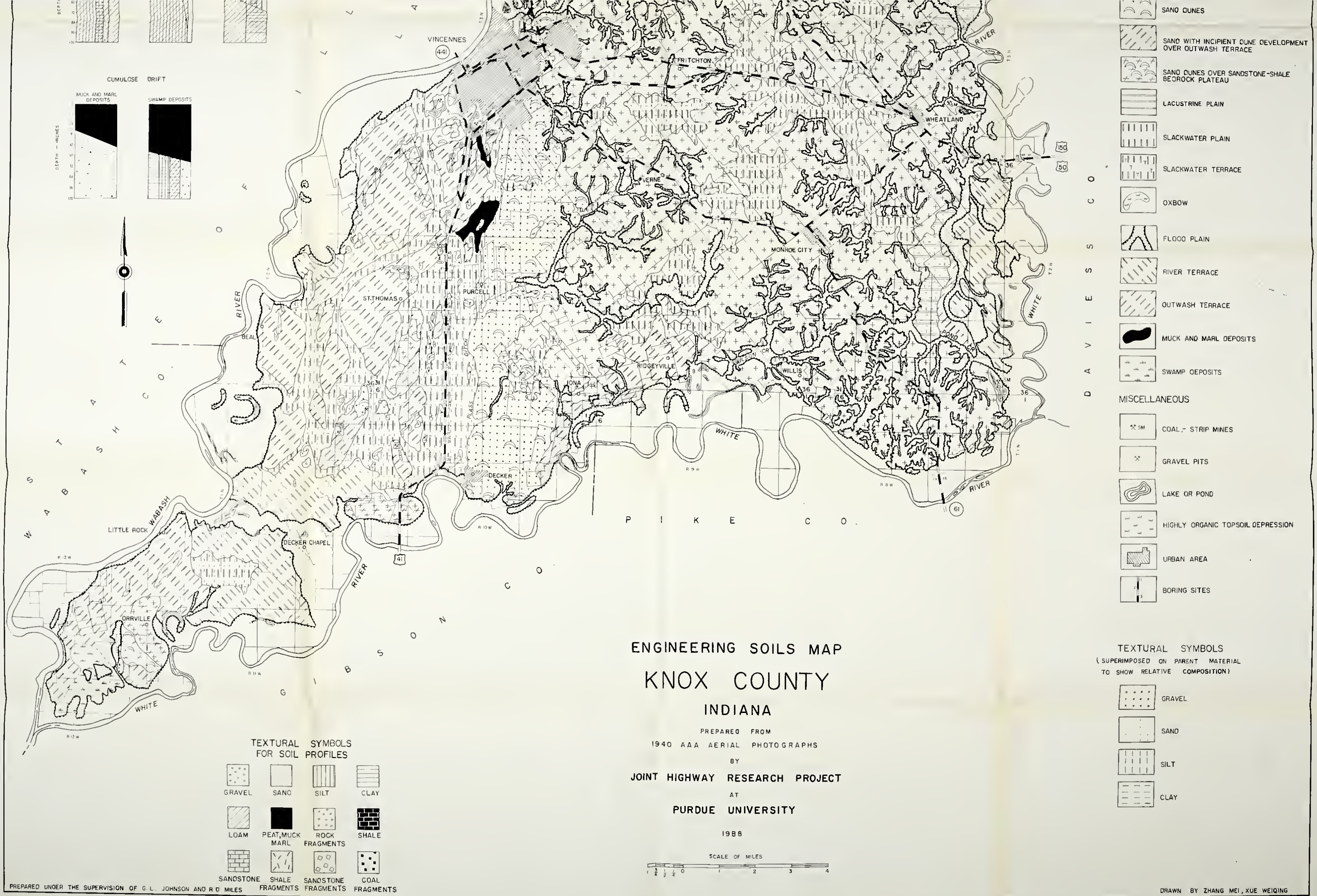
JHRP 88/16


GENERAL SOIL PROFILES
EOLIAN DRIFT
LOESS PLAIN
LOESS OVER SLACKWATER PLAIN
LOESS OVER SANDSTONE SHALE BEDROCK
COAL-MINED LAND
SAND DUNE
SAND WITH INCIPIENT DUNE DEVELOPMENT
SAND DUNES OVER SANDSTONE-SHALE BEDROCK
GLACIAL FLUVIAL DRIFT
OUTWASH DEPOSIT
LACUSTRINE DRIFT
LACUSTRINE PLAIN
SLACKWATER PLAIN
SLACKWATER TERRACE
OXBOW
FLUVIAL DRIFT
WABASH AND WHITE RIVER FLOOD PLAINS
UPLAND FLOOD PLAINS
RIVER TERRACE
CUMULOSE DRIFT
MUCK AND MARL DEPOSITS
SWAMP DEPOSITS
DEPTH — INCHES
SULLIVAN CO
GREENE CO.
CRAWFORD CO
LAWRENCE CO.
ILLINOIS
STATE OF
DAVIESS CO
KNOX CO
41
150
59
69
67
58
358
50
441
36
R10W
R9W
R8W
R7W
R6W
T5N
T4N
T3N
T2N
OAKTOWN
FREELANDVILLE
WESTPHALIA
SANDBORN
BUSSERON
EMISON
EDWARDSPORT
BICKNELL
BRUCEVILLE
JOHNSTOWN
ALICEVILLE
SNAPP
VINCENNES
FRITCHTON
WHEATLAND
VERNE
MONROE CITY
WABASH
RIVER
BUSSERON
WHITE
RIVER
INDIAN
MARIA
LEGEND
PARENT MATERIALS
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)
LOESS PLAIN
LOESS OVER SLACKWATER PLAIN
LOESS OVER SANDSTONE-SHALE BEDROCK PLATEAU
SAND DUNES
SAND WITH INCIPIENT DUNE DEVELOPMENT OVER OUTWASH TERRACE
SAND DUNES OVER SANDSTONE-SHALE BEDROCK PLATEAU
LACUSTRINE PLAIN
SLACKWATER PLAIN
SLACKWATER TERRACE
OXBOW
FLOOD PLAIN



ENGINEERING SOILS MAP

KNOX COUNTY

INDIANA

PREPARED FROM
1940 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY

1988

PREPARED UNDER THE SUPERVISION OF G.L. JOHNSON AND R.D. MILES

DRAWN BY ZHANG MEI, XUE WEIQING

COVER DESIGN BY ALDO GIORGINI